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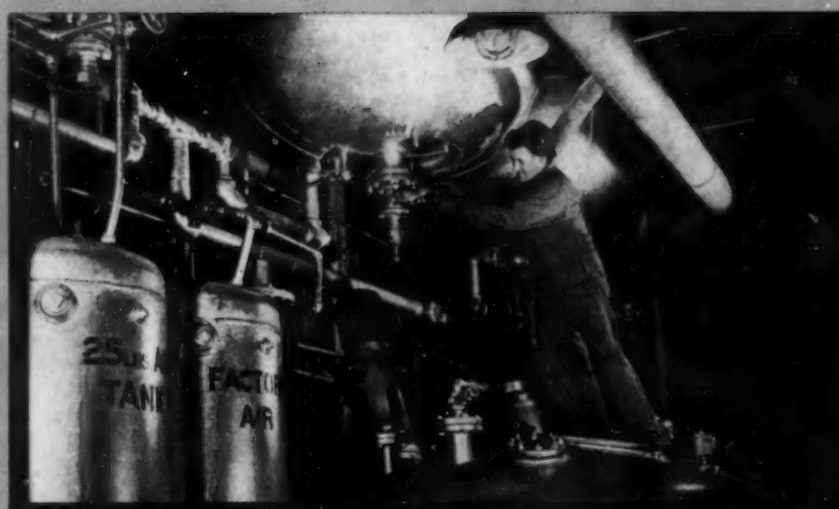

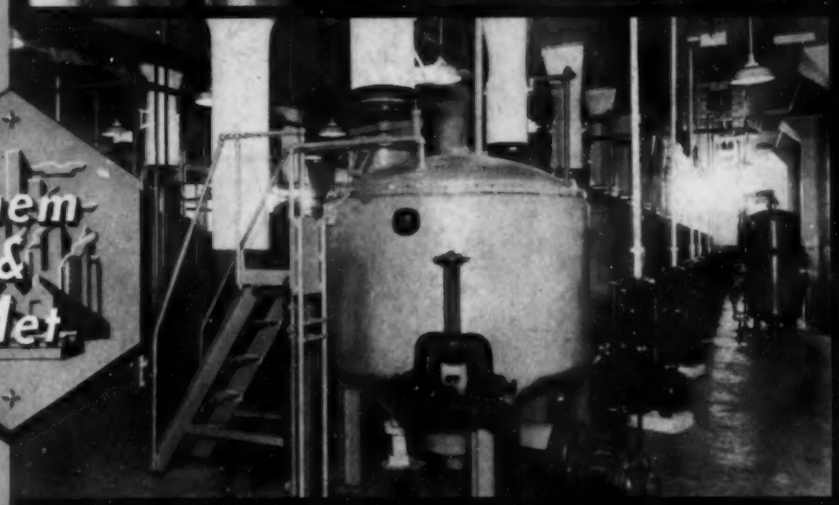

Chem & Met

OCTOBER, 1942

BARUCH, COMPTON, CONANT REPORT TO THE PRESIDENT

At last the discord in the rubber situation has been brought to an end by the excellent report of the Committee and the synthetic rubber program may now proceed without fear of further disruption. For excerpts from the report see pp. 83-87.

UNCONVENTIONAL METHOD SAVES TIME AND MATERIALS

Continuous spinning of viscose rayon, first practiced in Painesville plant of Industrial Rayon Corp., compresses into six minutes operations which by batch methods require up to 90 hours. The time saving is indicative of the tremendous reduction of material in process and of labor. For a pictured flowsheet of the operations see pp. 116-119.

CHEMICAL INDUSTRY'S SCRAP GOES TO BATTLE

Smokeless powder, TNT, tetryl and ammonium picrate will be used against the enemy in tanks, trench mortars, aerial bombs and machine guns made from worn out chemical engineering equipment. One company alone has contributed to date sufficient scrap to provide equipment for a sizable tank force. See pp. 92-93.

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- Cold Springing
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- Viscosity Conversion Chart
- Pressure Loss Chart
- *Flow of Flashing Mixtures
- *Steam Flow Through Pipes
- Properties of Pipe
- Dimension Tolerances for Welding Fittings and Flanges
- Pressure Ratings for Flanges
- Physical and Chemical Requirements for Flanges
- Pump Capacities
- Hardness Conversion Table
- Gas Density
- Table for Gauging Horizontal and Cylindrical Tanks
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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

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NEXT MONTH

More than a third of the normal peacetime production of the chemical process industries originates in the fourteen states west of the Alleghenies, north of Tennessee and east of the Rockies. On top of that, millions of dollars worth of plants for chemical munitions have been built so that today our vast midwest empire is of strategic importance to all *Chem. & Met.* readers.

The Second National Chemical Exposition to be held in Chicago next month is primarily an expression of the growing chemical consciousness of the Middlewest. It is an increasingly important factor in consolidating all of the forces that are strong and will become stronger in molding the Midwest empire of the future.

It is appropriate, therefore, that the November issue of *Chem. & Met.* should be built around "The Resources and Resourcefulness of the Corn Belt."

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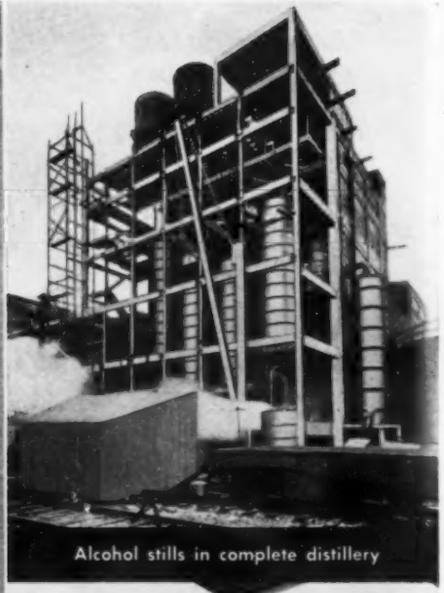
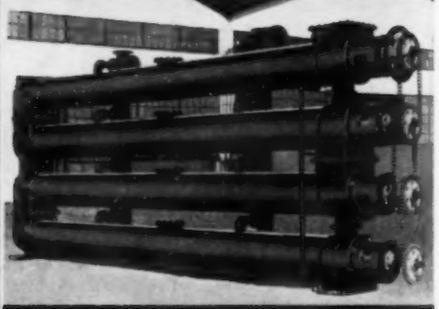
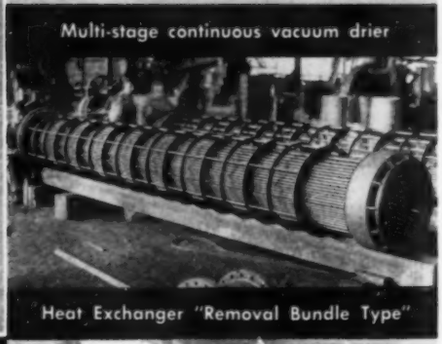


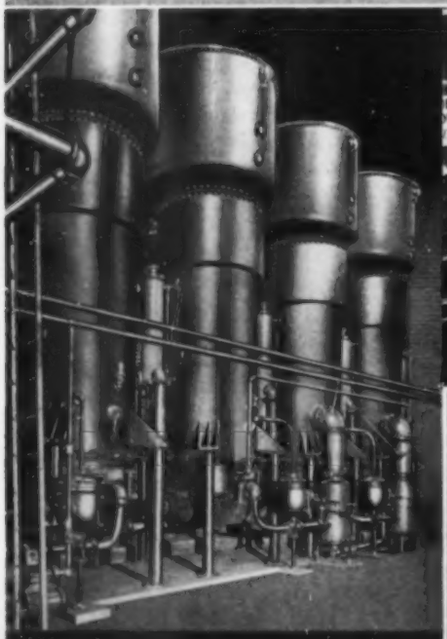
Alcohol stills in complete distillery



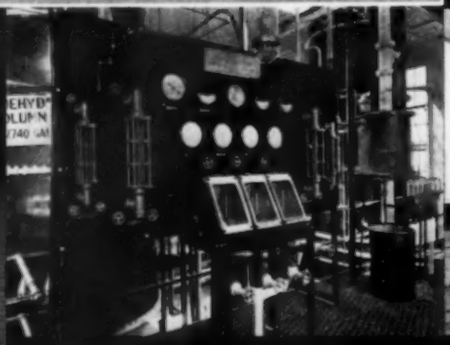
Multi-stage continuous vacuum drier



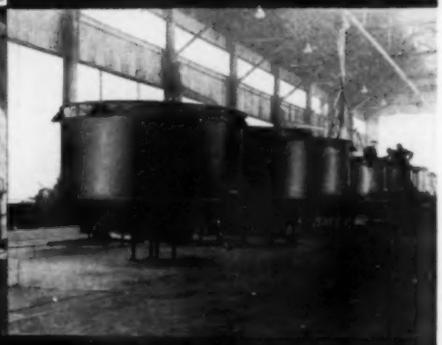
Heat Exchanger "Removal Bundle Type"



Battery of evaporators



Operating floor of complete distillery



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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, *Editor*

OCTOBER, 1942

SO MUCH...ON SO LITTLE

CIRCUMSTANCES sometimes dictate that the engineer must make an adequate decision on the basis of inadequate data. The inherent risk varies with the confidence one has in the integrity, knowledge and experience of the man or men involved. In the case of the Baruch-Compton-Conant report on the rubber situation, the nation receives its recommendations with the feeling that no group under present conditions could have given us a better appraisal of an exceedingly serious and complicated problem. Engineers and other technical men have special reason to be gratified and encouraged by the committee's recognition of the essential role that science and technology must continue to play in the synthetic rubber program.

In all the terse, clear-cut conclusions of this classic report, one paragraph stands out as a striking tribute to the work of the engineers behind the scenes who have carried so much of the burden and responsibility of the whole effort. "It is fortunate," says the report, "that the program for the needed plants is generally in the hands of as competent engineers as there are in the country. Probably the most interesting and satisfying part of our study is the confidence we have acquired in the men from industry who have the plans in hand and who are satisfied they can lick the problem in the given time. Their competence and experience, their resourcefulness and ingenuity, are the best guarantees we have that they can do so.

"We have been much impressed with the fact that the stupendous undertaking is only possible because of the highly developed skill of our technologists. No one could have examined the facts before us without appreciating the magnitude and scope of the task; no one could have made this study without realizing that because of the shortsightedness and failure to act on technically sound advice we must now proceed with insufficient experience. *We venture the statement that never on the basis of so little has so much been involved.*"

That mistakes of the past should not be repeated in the future is the grave concern of the committee in making its strong recommendation for the establishment of a competent and adequately staffed technical division under the immediate control of the Rubber Administrator. All phases of research, development, construction and operation of the program must be based on sound advice. Never again must we have such "a chaotic situation in which nontechnical men have made decisions without consultation with subordinates nominally in positions of responsibility."

Looking beyond the organization chart and the mere mechanics of administration, the committee recognized the necessity for continuing advance in research and development. It urged free "technological competition" and the "beneficial rivalries of the best brains in industry." It held that, on the one hand, "there should be a complete interchange of information and, on the other, as much competition in research, development and operation as possible. Such, after all, are the conditions applying in the fields of laboratory science where tremendous strides have been made during the last hundred years. Competition and cooperation in this new national effort, we believe, must go hand in hand."

It is our considered opinion that never before have we read a governmental report which so clearly analyzed a highly technical and complicated problem and at the same time laid the only ade-

FROM AN

quate basis for its solution. It is a challenge to every American citizen to do his part in meeting the national crisis. It is addressed particularly to chemical engineers. Never before in our brief industrial history has so much depended on so few.

MORE ALCOHOL PLANTS?

PERHAPS there is legitimate ground for questioning one technical recommendation in the Baruch Committee report. Even if one does question that statement, as we do below, the report sets an all-time high for government documents in its technical reliability.

Our question relates to the need for the building of additional alcohol plants in the agricultural states near water transportation. We do not believe that the objective rightly sought in such a recommendation can best be reached by that route. It is clear that without building new plants there is abundant alcohol manufacturing capacity potentially available in beet-sugar plants, sugar refineries, and certain syrup works already in existence. Several large sugar refineries alone could each produce 30 million gallons of alcohol from grain if they were merely given some packed tower stills. They could adapt existing refinery equipment to every other operation than the concentration of the high wines into industrial alcohol. Surely that technique of alcohol making is much the most economic in the use of critical materials and machinery.

The government technical men know this. Unfortunately, however, many of the politicians in Congress refuse to believe it because they still would like to have alcohol plants in their home districts.

It is not yet clear whether we shall need more alcohol late in 1943 than is already assured from going plants and plants nearing completion. But if we do, there are good chemical engineering means for producing at least 200 million gallons of additional industrial alcohol from grain in the manner above described.

CONSERVE TECHNICAL SKILLS

TECHNOLOGICAL skill of the scientist and the engineer is a great wartime asset. Every public official gives lip service to this fact. Unfortunately, many important officials having to do with manpower questions do not also give administrative support to it. The result is two serious threats of great concern to chemical engineers and to those who need their skilled service.

The first threat is that far too many scarce technical men skilled in chemical engineering, chemistry, and physics, are being allowed to go into non-technical military activities, or are being forced to, with a great national waste of skilled manpower. Fortunately, many, probably most, of the state and local Selective Service boards have recognized the error of such a policy and are doing their best to conserve these skills for their greatest usefulness. But even a few leaks are unfortunate.

Far more dangerous, and far more significant, is the action of Army and Navy officers in recruiting technical manpower for commissioned officers for land, sea, and air services. Apparently, every recruiting unit that goes near a campus makes its first raid on the engineering college. The reason is obvious. The type of young man who makes a most promising engineering student is also a most promising officer candidate. Unfortunately, the recruiting agencies take these men for many jobs for which their engineering or scientific talent is not required. Even though a young engineer may make a splendid deck officer on a ship, a resourceful aircraft pilot or observer, or a very fine infantry officer, there is no excuse for allowing this scarce type of young technical skill to be diverted to those applications. Yet literally thousands of young engineers and scientists have been so taken.

Simultaneously, the technical services of Ordnance, Engineers, Chemical Warfare, and the manufacturing units which provide materiel, are shouting for a greater number of young technical workers in research, development, design, and the engineering aspects of plant operation and supervision. They cannot get nearly enough for the direct military jobs which they must do, both in uniform and in civilian projects.

These facts are recognized by high ranking officials in the War Manpower Commission. They

EDITORIAL VIEWPOINT

are recognized in theory by Selective Service. They are recognized by advisers to the Secretary of War and the Secretary of the Navy. But nothing happens to correct the evil. It seems most unfortunate that top official action does not stop this diversion of skill into jobs for which special skill is not required. If for no other reason than to supply the *technical* uniformed services adequately, these men should be conserved for technical jobs. And if industry is to do its maximum in production, certainly there should be some besides the cripples and morons left for it.

ATTENTION DRAFT BOARDS!

ADDRESSING itself to the "highly competent man" whom the Baruch committee assumed that the Rubber Administrator will immediately place "on a full-time basis in charge of his technical division," the report included this significant suggestion:

> 9. The Committee suggests the institution of a prompt survey to determine the number of chemical engineers and other technically trained men who will be required to operate the synthetic rubber plants now under construction. And if this survey indicates a serious shortage of such technical talent, the Manpower Commission should be called upon for assistance in devising a policy for meeting the situation.

It is our impression that the Commission, through the National Roster and U. S. Employment Service, had already anticipated this suggestion. So had at least one of the engineering societies. There seems to be a need developing for at least 2,000 recent graduates, which is considerably more than the supply. When you have the chance, bring this serious situation to the attention of the members of your local board.

WASHINGTON HIGHLIGHTS

FATS AND OILS will be abundant; but extensive restrictions on use are imposed. These seeming conflicts of official conclusion represent rational precautions in handling a difficult situation. The total supply of fats and oils potentially available will be adequate despite large Lend-Lease and unusual military uses. But certain types of oils will not be abundant, notably drying oils and certain soap oils. The one constructive feature of the whole situation is the fact that in revision of Order M-71 the technical men of W.P.B. have recognized the interdependence of all oil-using industries. They have imposed restrictions on each of the major user groups on a coordinated basis. Perhaps no group is going to be entirely happy with its own restrictions; but they can be happy in the thought that an honest effort is made to have everyone share reasonably in the responsibility for curtailment.

BARUCH style reviews are needed for other things than rubber. That fact was clearly indicated in the Baruch report itself. Official Washington understood the meaning of this implication. That there are not other Baruch committees already working on manpower and food problems—to mention but two needs—is partly because there are not enough Baruchs, Conants, and Comptons. Also, this idea tastes about like loose quinine officially.

QUALITY of industrial goods will be critically reviewed by a newly created "Standards Division" of O.P.A. That agency will undertake to prevent the up-grading in name, and in price, of inferior industrial materials or the "skimping of measurements and workmanship." The obvious and important purpose is to prevent price ceilings from bulging upward badly under the strain of quality changes which are not directly covered in a price ticket. Chemical makers will have little to do with this new Division; but chemical engineers making other kinds of goods for which quality standards are a bit vague may need to set up programs of active cooperation. If the leaders in each industry do this promptly, they can prevent the occasional shyster from doing damage to a whole industry.

"NOT TOO FAST" production of a few chemicals is a suggestion from Washington worthy of note. Producers and distributors of industrial chemicals will know sooner than official Washington when they should slow down on output. Self-restraint, for industry inventory controls, will be wise. It is much easier to accomplish self-regulation in these matters than to be subjected to a multitude of official restrictions, quotas, allocations, and priorities. Many chemicals can escape from any need for official regulation if the producers are a bit thoughtful.

An American Source of Natural Resins for the Paint and Varnish Industry

ADRIAAN NAGELVOORT *Chemical Engineer, Salt Lake City, Utah*

***Chem. & Met.* INTERPRETATION**

With this country's source of natural resins now cut off by the war and chemicals used in synthetic resins increasing in scarcity, the paint and varnish industry will be particularly interested to learn of the extensive deposits of fossil resins recently discovered in Utah. Development of these deposits, estimated to be sufficient for well over a century, may prove to be of major economic importance to the domestic protective coatings industry. Herein the author, a prominent chemical engineer, describes the nature of these fossil resins and his processes of separation and purification.—*Editors.*

AMERICA'S SUPPLY of natural resins has been wholly dependent on foreign sources that are now cut off. The East Indies shipped us damar, pontianak, boea and loba. From the Phillipines we got manila, from New Zealand kauri, from Australia sandarac and accroides, from Africa sandarac, mastic and congo copal. In the trade these resins are usually designated as "gums" but this, of course, is a misnomer. They are true resins and are either of fossil origin or are tappings from standing trees. They have one characteristic in common: all are used in making protective coatings, in oil varnishes, spirit varnishes or incorporated in paints, lacquers, inks or linoleums. Most highly prized are the fossil resins, since they make the best and most satisfactory surface coatings for most industrial purposes.

There has recently been discovered in certain of our western states a supply of fossil resins great enough to satisfy the entire domestic needs for the next hundred years or more. In origin, these deposits are similar to the imported fossil resins in that both are from prehistoric coniferous trees. Geologically, those of the United States are much older and hence, in some respects, are better for the paint and varnish industries.

Within this dotted area of Utah lie extensive deposits of resin-bearing coals

UTAH RESIN DEPOSITS

Towards the end of Cretaceous time and before the beginning of the Tertiary period the western plains of the United States were covered with dense forests of conifers, the ancestors of our sequoias and pines. Such trees are prepared for a long life because of their effective means of protection, including waxes that cover their leaves and resins that protect their bark and wood. These waxes and resins probably represent nature's best chemistry in the making of protective coatings.

In Utah, especially, but also in the states of Colorado, New Mexico and Washington certain seams of the Cretaceous and early Tertiary coals contain the fossil remains of the resins and waxes of the conifers of those times. These coals are bituminous, but they are much younger than the bituminous deposits of the eastern seaboard and the middle west, which are of the carboniferous period or about twice as old. Geologists estimate their age as between 30,000,000 and 80,000,000 years. That these resins have withstood for so long the corrosive action of ground waters that have at times been acid and alkaline as well as salty shows that nature's chemistry has been good. Indeed, it has been so good that the protective coatings have withstood the ravages of time better than the wood fibers they were meant to protect.

In the Utah coal field between Castlegate on the north and Salina canyon on the south, a distance of 70 miles as the crow flies, there are certain seams about 14 feet in thickness in which these resins constitute about five percent of the coal. The resins look like amber and vary in color from water-white through lemon yellow to deep, dark red. They occur in thin lenses from paper thin to one inch or more in thickness.

Two main problems had to be solved in order to prepare these resins for commercial use. The first was the technique of mineral separation: to recover the resin cleanly from the coal. The next was that of processing the recovered resins so that they could be used in the making of light-colored varnishes to meet the varnish makers' most severe tests.

RESIN-COAL SEPARATION

Usual mineral separation processes were tried on the resin-coal mixtures without any noteworthy success. Using water as a medium, jigs and tables did not give a good resin recovery and the product contained too much coal. Froth flotation, using pine oil or other frother, likewise gave a poor recovery and an inferior resin product. Better results were obtained in a flotation cell without the use of a frother but using instead a wetting agent for the coal. Air separation and electrostatic separation did not give satisfactory results. None of these methods allowed a clean separation of the resins from the coal or a separation of the waxes from the resins. This latter step is important to the varnish maker, who cannot tolerate any wax in his varnish.

Table I—Certain Characteristics of Utah Natural Resins from Coal

Melting point, crude	165 deg. C.
clarified # 1	250 deg. C.
clarified # 2	120 deg. C.
Acid number	6
Hardness	same as Congo
Soluble in:	Benzol, toluol, turpentine, xylol, naphtha, chlorinated hydrocarbons, linseed, soya, tung, castor oils.
Insoluble in:	Alcohol and unaffected by weak acids or alkalis.

A study of the physical characteristics of the coal, resin and wax showed the specific gravity of the coal to be 1.280, that of the resin to be 1.02-1.06, while that of the wax was less than 1.0.

Coal is not readily wetted by water nor by an aqueous salt solution, but it is wetted by water or a salt solution containing one part of tannic acid per million parts of water. Furthermore, neither the resins nor the waxes are wetted by solutions of such dilution. However, at a strength of one part of tannic acid per 100,000 parts of water or salt solution the resins but not the waxes are wetted. Wax is the most difficult of all to wet. Utilizing these facts, a very simple sink-and-float process was devised by which these coal constituents could be separated.

To break apart mechanically the resins and wax from the coal, it is first necessary to crush the coal to pass a 10 mesh screen. Finer crushing is neither desirable nor advisable. Indeed, crushing the coal to pass a one inch screen is sufficient to release most of the resins and wax. This is due to the fact that on breaking, the coal parts along the resin seams which therefore, since it is more friable than the coal, is easily released. Coal so crushed is easy to market as a stoker product while pulverized coal is difficult to market. Besides, the resins are not too much pulverized for easy handling in the sink-and-float apparatus. By crushing only to one inch, about 85 percent of the resins are found to be in the sizes below 10 mesh.

Crushed coal is first screened over a 10-mesh screen. The oversize goes to market as such while the undersize is sent to the wetter, a device like a log washer or screw conveyor where it is wetted with a salt solution having a specific gravity of 1.10 and which contains one part of tannic acid per million parts of water. Only the minimum quantity of water is used, just enough to make a thin paste, since it has been found that coal is more readily wetted in this condition.

From the wetter, the coal paste flows with more of the salt solution to the sink-and-float tank, which is a V-shaped vessel or an invert-cone like a "callow" cone provided with means for drawing off the sunken coal and for overflowing the floating resins. The floated resins go to a mechanical filter while the barren coal is then sent to a filter bed of the type used in treating city water. Here the salt solution is recovered for reuse and the coal is washed to recover any adhering salt. The washed coal then goes to a dryer to be later used in making smokeless fuel or coke or for use as a pulverized fuel.

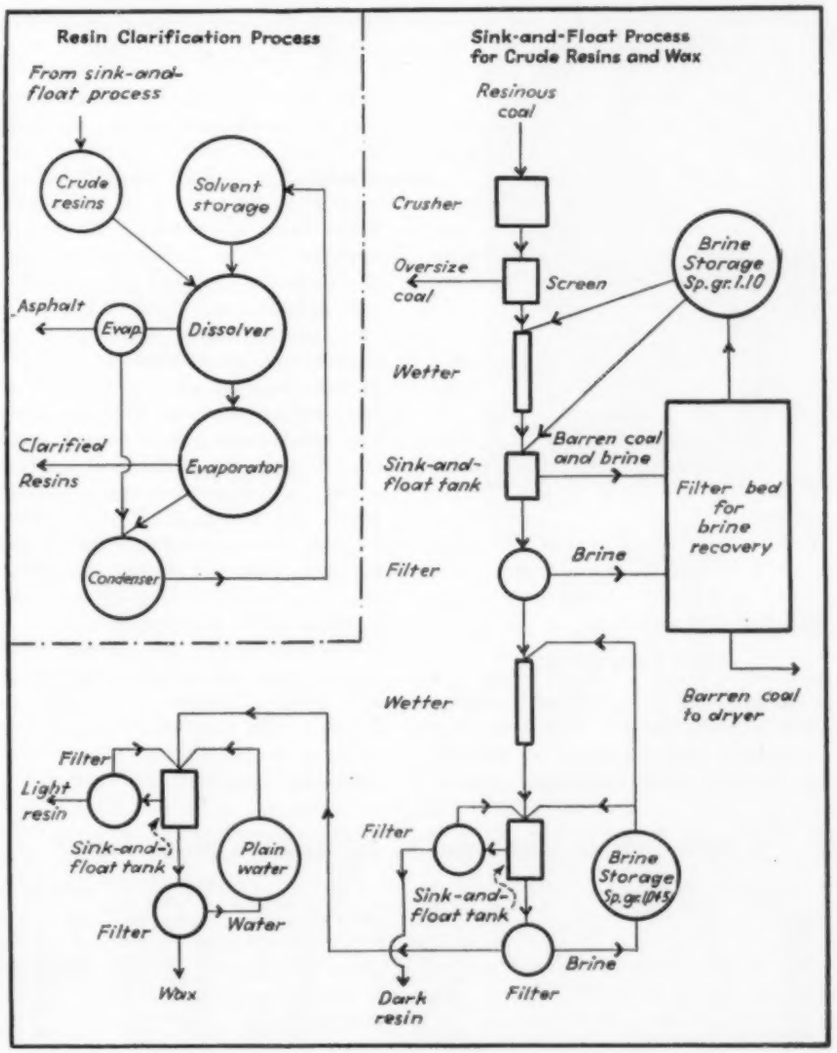
RESIN-WAX SEPARATION

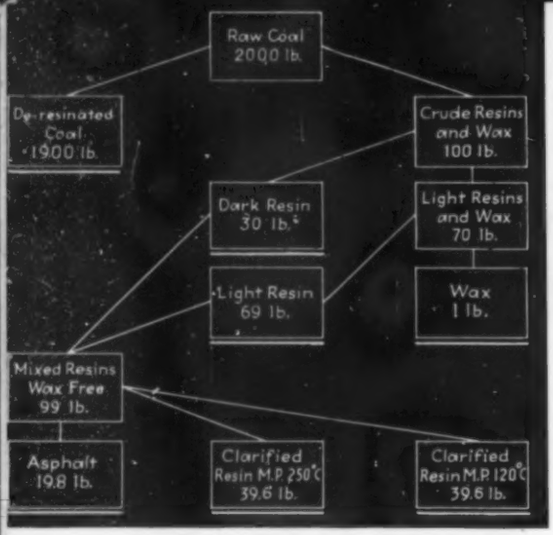
The surface area of a sink-and-float tank determines its productive capacity. Such a vessel with a surface of 10 square feet has a capacity of 100 tons of coal per day or five tons of resin per day.

Floated resins, after filtering but still wet, go to a second wetter where they are treated with a salt solution having a specific gravity of 1.045 and which contains one part of tannic acid per 100,000 parts of solution. This will wet the resins but not the waxes. These then flow to a second sink-and-float tank where the heavier

Light areas in this piece of coal represent seams of friable fossil resins

Flow sheet of processes for obtaining varnish-grade resins from Utah coals





Yields and products from Utah resinous coals, with marketable items underlined

resins sink and the lighter resins and waxes float. These heavier products are deep, dark red in color and constitute some 30 percent of the total resins. They are recovered, washed and dried and used where color is of no consequence to the final product.

The floated resin-and-wax mixture then goes to a second mechanical filter where the salt solution is recovered for reuse. The mixture next flows to a third sink-and-float tank which contains plain water. Here the light-colored resins sink, are recovered, washed and finally dried. They can be used in the preparation of so-called "dark colored" varnishes.

While the light resins appear clear and lemon-colored to the eye, on cooking with any of the drying oils they result in varnishes that are too dark to compete with the light varnishes of commerce.

Floated waxes from this last sink-and-float operation constitute about one percent of the total resins. As yet, not enough work has been done on these constituents to determine where they best can be used in industry. It is necessary, however, to remove these waxes as they will cause any varnish to craze and crack. They are as soft as talc and have a melting point of 100 deg. C.

RESIN PURIFICATION

Experimentation with various solvents has revealed the interesting fact that these resins contain an asphalt in solution. Removal of this asphalt was the second part of the problem that had to be solved in order to make a product that could compete on even terms with the foreign resins. The Utah resins are soluble in benzol, toluol, xylol, naphtha, carbon bisulphide, the chlorinated hydrocarbons and the drying oils. However, they are not soluble in alcohol, acetone, the hydrocarbons of the paraffin series nor most of the other organic solvents. Asphalt is also soluble in these. Ether alone dissolves most of the resins without dissolving much asphalt.

A combination of solvents actually proved to be an effective means for separating the asphalt from the resins. A mixture of 60 percent naphtha and 40 percent alcohol dissolves the resins completely and precipitates the asphalt as a black, sticky mass that settles rapidly out of the solution. Recovery of the resins is then a matter of decanting off the clear resin solution and evaporating the solvent and recovering.

Since the resins are colloids, the solution is strictly speaking a mixture of resin and solvent, which are miscible in all proportions. A mixture of six parts of solvent for each part of resin makes a fluid that is easy to handle and yet one in which the asphalt settles rapidly and cleanly. The asphalt actually constitutes some 20 percent of the resins. When using as solvent a mixture of naphtha with a boiling point range of 40-60 deg. C. and ethyl alcohol with a boiling point of 78.4 deg. C., the naphtha boils off first and changes the proportions of the two solvents so that the resin begins to come out of solution. The first resin that precipitates has a melting point of 250 deg. C., while that portion which stays in solution has a melting point of 120 deg. C. It is therefore possible to separate two resins in this manner, both of which are about equal in quantity. Both types make good light-colored varnishes.

Characteristics of these Utah resins which are of most interest to the varnish maker are listed in Table I. The clarified resins go into solution in the drying oils without "running" and leave no residue.

A typical 25 gallon varnish made with dehydrated castor oil cooked for an hour and twenty minutes at 560 deg. F., thinned with mineral spirits, driers added in the proportion of 0.5 percent Pb and 0.01 percent Co dried to give a tough, high-gloss flexible film dust-free in two hours and tack-free in four hours.

POTENTIAL SUPPLY

Utah mines now produce about 90,000 tons of coal per week. The miners avoid the resin-bearing coals as much as possible as the consumers object to its speckled appearance and the excess soot it produces. However, about 14,000 tons or some 15 percent of the total coal actually mined is resin-bearing. With an average of five percent resin content, this represents about 100 tons of resin per day that goes up in smoke and soot to dirty our cities.

Experiments have shown that removal of the resin improves the coking quality of the coal. This opens a large field for the industrial use of these resinous coals. Salt Lake City consumes about 1,000 tons of fuel per day. If this were all of a smokeless grade it would represent about 2,000 tons of coal or 100 tons of resin per day that could be recovered from this tonnage. Other users of smokeless fuel or coke could easily bring the daily resin production up to several hundred tons, easily enough to take care of the entire requirements of the domestic paint and varnish industry. Table II shows United States imports for consumption of natural varnish-type resins during the past several years.

The State of Utah has been giving serious consideration to making an appropriation to provide for an initial plant for producing about five tons of resins per day. This plant will demonstrate the process and quality of the product, after which it is hoped that an appropriation from the Government will provide for a plant sufficient to take care of the present industrial needs of the country.

World War I exploded the idea that only Germany could make dyes and fine chemicals. This present war should free the United States of dependence on foreign sources for its supply of natural resins. Furthermore, the utilization of our own natural resins at this critical time would also release for more important war uses some of the glycerin, alcohol, phenol and other chemicals that are now being used in large quantities in making synthetic resins.

Table II—United States Imports for Consumption of Varnish Gums[1]

	Damar	Kauri	Other Varnish Gums	Total in Lb.
1935	15,004,904	1,386,821	20,569,307	36,961,032
1936	15,707,671	970,484	20,383,225	37,061,380
1937	18,167,512	2,139,207	24,788,544	45,095,263
1938	11,541,965	767,014	16,494,033	28,803,012
1939	17,334,581	1,020,632	23,941,313	42,296,526
1940	19,110,593	1,561,135	33,360,745	54,032,473
1941 (9 mos.)	19,138,415	533,690	23,152,196	42,824,301

[1]Division of Foreign Trade Statistics, U. S. Dept. of Commerce.

Baruch-Compton-Conant Report Challenges Us All

JOSEPH A. CONRY

Former Member of Congress and U. S. Minister to Russia, Washington, D. C.

Chem. & Met. INTERPRETATION

President Roosevelt and others have correctly appraised the report of the Rubber Committee as one of the most outstanding public documents of this war—a great service to the Nation in time of dire emergency. By clarifying in the public mind a maze of conflicting and complicated impressions, it clears the decks for national action—gasoline and rubber rationing, salvage and reclamation as a means of necessary conservation and, most important to chemical engineers the prompt acceleration of the synthetic program as the only hope for keeping the war rolling on rubber! Broader considerations of the report in relation to the public interest are reviewed here by a former member of the National Legislative and Diplomatic Services of this country whose long experience and disinterested viewpoints lend proper perspective to such a history-making study. Then follows selected excerpts from the full report which deal directly with problems of chemical engineering concern.—*Editors.*

O.E.M. photos by Palmer

Removing sheets of synthetic rubber from a vacuum dryer

It is doubtful if any government report ever received such eager scrutiny as the Baruch-Compton-Conant report on the rubber situation. It was a prize essay in style, the joint composition of two scientists helped by a skilled executive, a trio eminent for knowledge and sage philosophy, capable of lifting criticism to a higher standard than any hitherto reached in public reports.

The daily papers gave it front-page space with heavy headlines in deepest black, marking the deadline of delays, incompetence and conflicting authority in certain branches of the service where imperfection thrived like weeds in an unkept garden.

The success of the report was manifest in the universal satisfaction shown on its publication. President Roosevelt set the style by applauding it as "Excellent" and declared his intention of adopting all of its recommendations so that it might be made operative without delay. He appointed a well-seasoned executive. Mr. William M. Jeffers, president of the Union Pacific Railroad System, to systematize rubber conservation and production, just as he had developed his great transportation system. Mr. Jeffers is generally accepted as the type of American the committee had in mind when it suggested a man able to lick all the problems and difficulties unearthed in the investigation.

Mr. Jeffers at once admitted he was innocent of any technical knowledge of rubber. To some this may mean a serious handicap, but to others it is proof that he is free from all prejudices as between competing interests and processes, thus giving a warm invitation to the chemical engineers of the country to appear as *Amicus Curiae* (See *Chem. & Met.* Sept. 1942, pp. 186-9) with assurance that their advice would be not only received but cordially welcomed.

His authority under Executive Order will be so crystal clear that no other agency will be tempted to question his power. It is of incidental interest to note that the creation of this office was what was sought by the Congress in the passage of Senate 2600, a bill to provide for a "Director of Rubber Supplies." This bill, of course, brought a veto from the President, but it also brought the appointment of the Baruch-Committee so that, in a sense, the Western Senators who were responsible for the passage by Congress of this bill have secured by Executive action what they sought by legislation.

At least a part of the demands of the farmers were recognized by the Baruch Committee in its recommendation for a building of a plant for the production of 30,000 tons of Buna-S, to be located near the grain area, to be "operated under the control of a local group." Also the significant recommendation was made

Control instruments in polymerization tanks maintain proper temperature

that facilities for production of 100,000,000 gal. of alcohol be erected on sites near the grain-producing area and accessible to water transportation.

No delay is to be permitted for the immediate operation of the plants for synthetic rubber from petroleum. Thus both of the great interests involved are assured of sympathetic advice in working out their problems. The committee suggested and it is certain that chemical engineers and other competent technical men will be at hand for the assistance of the director with only one thought animating their action, to produce rubber.

Mr. Jeffers has before him the formula of re-creating our industrial system with full knowledge of the value of a free and unbiased professional body of advisors. He is to be the catalytic power of the Baruch report. Competent men will supplant "good fellows." Should some smaller person vain of his political pull impinge on the work of the boss his vanity will be sadly bruised or even destroyed. There is only one way to run a ship, the captain must be in command.

Having the authority, he must have the financial strength and it is significant that the report recommended that the funds required for the entire rubber program be put directly at the disposal of the Rubber Administrator instead of indirectly through the Reconstruction Finance Corporation.

Analyzing this now famous report, one is impressed with the fact that while criticism ran free, fierce and furious, at no place in the report does evidence appear of an approach to personalities.

Failure to take advantage of the alleged Russian offer to provide reports of Soviet efforts and success in producing synthetic rubber has not yet been explained. If Mr. Baruch were unable to get the reason, there is only one man in Washington able to ferret out the true story. He is the President. To him alone is responsible the Secretary of State who controls all the secrets of our foreign relations. Perhaps the offer might have been a bi-lateral one intimating certain considerations not at all feasible at this time.

Mr. Jeffers is urged to go ahead without delay on the present program for the production of synthetic rubber under those processes known to be sound. He is to have "an adequate technical staff under his immediate supervision" and he must not wait for perfection.

He has been told a weapon on the battlefield is better than on a blueprint, as he well knows that a locomotive on the rails is worth a dozen in the repair shop. So with the blessings of the Committee, he is told to produce during the year 1943, 400,000 lb. of Buna S, 30,000 tons of neoprene, 62,000 tons of butyl rubber, and 24,000 tons of Thiokol. If he carries out this program, he will lift a great burden of worry from the American people.

The Synthetic Rubber Program

Excerpts from the Baruch-Compton-Conant Report as transmitted to Congress by the President of the United States September 10, 1942.

SUMMARY: To safeguard the military situation in the critical year of 1943 against the possible delays in synthetic rubber production, or failure to secure crude rubber imports or further expansion of requirements dictated by enemy actions or new strategy; also to provide the additional rubber needed to maintain the civilian automobile use considered absolutely essential; the Committee recommends (1) that there be no further substitution in the plans for the synthetic program now laid down; (2) immediate authorization of an additional 140,000 tons of Buna-S capacity per year; (3) the immediate institution of a refinery conversion program to yield a total of 100,000 tons of butadiene in addition to that now planned; (4) the immediate adjustment in the rates of construction of present styrene and polymerization plants in order to obtain the maximum production of Buna S in 1943; (5) the construction of an additional plant for the production of 20,000 tons of neoprene per year; (6) the erection of a 27,000-ton butadiene plant from grain and an associated polymerization plant to production 30,000 tons of Buna S, both to be located near the center of grain production; the construction to be started six months hence unless the Rubber Administrator determines otherwise; the process to be employed to be determined in the light of the information then available; (7) the immediate erection of alcohol plants to produce 100,000 gal. per year, using recently developed apparatus; the plants to be erected on sites near the grain-producing states and located on water transportation.

PRESENT STATUS

The present plans for the production of synthetic rubber as outlined to us by the governmental agencies concerned called for the erection of the following types of plants in the United States; (a) for the production of neoprene, eventual capacity 40,000 tons per year (in addition to a 9,000-ton plant now in operation by a private company); (b) for the production of butyl rubber to yield 132,000 tons per year; (c) for an over-all production of 705,000 tons of Buna S. This production of Buna S involves construction in terms of plants for producing styrene and butadiene and for the co-polymerization of butadiene and styrene with the formation of Buna S.

For the manufacture of butadiene the following processes are scheduled: (all figures expressed in the long-ton equivalent of Buna S).

1. from alcohol by the Carbide and Carbon Chemical process, rated capacity ..... 242,000 tons
2. from butane (in natural gas) by a process developed by the Phillips Petroleum Co. ..... 50,000 tons
3. from butane by the Houdry process ..... 16,500 tons

4. from butylene (obtained by the cracking of petroleum) by a process developed by Standard Oil Co. of New Jersey.....283,000 tons
5. by the cracking at high temperatures of gas and heavy oils (the so-called thermal or refinery conversion process) ..... 20,000 tons
6. by combination of (4) and (5) in one locality..... 93,500 tons

The Committee has examined the present status of the Government's schedules and estimates that *if the construction program can be met on the dates specified* there will be produced during 1943: 400,000 tons of Buna S; 30,000 tons of neoprene (in part from private sources). We believe that these processes will ultimately work on a large scale and yield satisfactory products.

Furthermore, our experts estimate that the time required to get the various plants running smoothly under actual operating conditions will not be so lengthy as to cause serious delay. On the other hand it must be remembered that we are dealing here with a new industry and that in the production of Buna S three separate manufacturing operations are concerned, no one of which has been carried out as yet on anything approaching the present contemplated scale.

Therefore, until more experience has been gained by the operation of one of the large-scale units at each step, we must consider that a considerable element of risk is present in the picture. The importance of completing rapidly one full-scale plant using each process and the erection of pilot plants is considered in the technical section of this report.

The Committee wishes to emphasize once again at this point that the whole question of obtaining synthetic rubbers in adequate amounts in 1943 hinges on the rate of construction of the manufacturing plants. Unless the present situation involving the assigning of priorities and allocating of materials is improved, there is grave danger that there will be serious delays in the completion of the plants and consequent reduction in the amount of synthetic materials produced. Furthermore, unless the administrative changes recommended in a later section of this report are put in to effect, conflicting governmental plans with respect to the oil industry may seriously jeopardize the production of butadiene.

OTHER PROCESSES

We have also examined with the aid of our experts many other processes for the production of butadiene and synthetic rubber. We find that quite apart from their merits or demerits, no one of them could now be substituted in the present program with hope of accelerating the production of Buna S in the critical year 1943.

We would be blind if we did not see the efforts now in progress on the part of many companies to have a part in the development of a large new industry with vast post-war possibilities. This has been accentuated in the minds of the petroleum producers, by gasoline rationing with its attendant loss of sales. They are thus forced to turn to other products including butadiene. Furthermore, we are not unaware that it is inevitable that once the war is over there will be a struggle amongst various groups for the control of this new industry. But all such considerations cannot affect this Committee as to its conclusions. We are concerned only with the production of the largest amount of rubber in the minimum amount of time in order to carry the country successfully through the war. It is our firm conclusion that present processes for manufacturing synthetic rubber and the raw materials required (butadiene and styrene) must not at this late date be changed unless new processes can be shown beyond peradventure to have such advantages over those now employed that more rubber would be obtained in the ensuing months than would otherwise be the case. We have found no such process in the course of our investigations.

The Committee finds that there has been considerable discussion between two groups within the oil industry as to whether or not there was a serious conflict between the butadiene program based on butylene and the high octane aviation gasoline program. With the aid of our experts we have examined carefully into this problem and consulted many technologists in various oil companies as well as discussing the matter with the officials of the Office of Petroleum Coordinator. It is our conclusion that, while the possibility of a conflict between the two programs does exist, it need not become serious if the possibility is recognized and if the administration of these two closely related enterprises is properly integrated.

The necessity for the administrative changes along these lines which are recommended elsewhere in this report is further demonstrated by the uncertainty of the stated aviation requirements both in quantity and quality. The evidence clearly indicates that if the present demands for high octane aviation gasoline and butadiene stay where they now are, there need be no conflict.

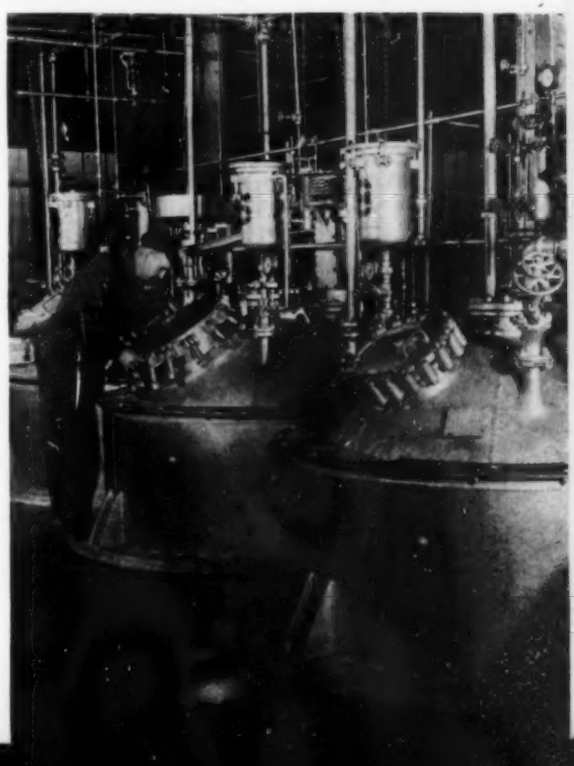
If and when the armed services should decide that such larger quanties of high octane aviation gasoline are needed, there are ways by which this demand can be met by the industry without diminishing the flow of butylene to the butadiene plants.

It is fortunate that the program for the needed plants is generally in the hands of as competent engineers as there are in the country. Probably the most interesting and satisfying part of our study is the confidence we have acquired in the men from industry who have the plans in hand and who are satisfied they can lick the problem in the given time. Their competence and experience, their resourcefulness and ingenuity are the best guarantees we have that they can do so. We have been much impressed with the fact that this stupendous undertaking is only possible because of the highly developed skill of our technologists. No one could have examined the facts before us without appreciating the magnitude and scope of the task; no one could have made this study without realizing that because of the short-sightedness and failure to act on technically sound advice we must now proceed with insufficient experience. We venture the statement that never on the basis of so little has so much been involved. Under these uncertainties the only recourse is to provide ample margins when in doubt.

THE PROBLEM OF 1943

The year 1943 is so critical for the rubber situation that the production of 100,000 tons more or less of Buna S might be a determining factor in the success of our military program. In view of the extremely precarious situation in 1943 the Committee recommends the prompt increase of 100,000 tons a year of butadiene over the present schedule, to be obtained by a refinery conversion program. This can be accomplished with a very small expenditure of critical materials. This recommendation is designed to accomplish three ends: (1) fill the gap between butadiene production and polymerization capacity in the early part of 1943 (for the minimum polymerization capacity exceeds that for butadiene production and according to present schedule the two will not come together until the middle of 1943); (2)

Polymerization tanks where raw materials of synthetic rubber are converted into latex



provide a reserve of stand-by capacity for the later years of the program; (3) furnish valuable insurance against contingencies affecting other plants in the program and provide additional facilities to meet possible increased demands of the armed services.

Due to the pressure from various sources there have been, even in very recent days, belated efforts to change from the present butadiene plants scheduled by the government to the refinery conversion processes. The first thought that occurs to the Committee is, "Why now? Why not months ago? Why the sudden activity? And, above all, why substitute at this late date?" We have recommended an *increase, not a substitution*, of a refinery conversion program. We have made this recommendation, in order to produce more rubber during the critical year 1943. We should like to emphasize again that it would be a major blunder to make a further change inside the program at this date by the substitution of one process for another.

To obtain the maximum utilization of the combined refinery conversion program, we recommend a prompt increase in the rate of construction of polymerization facilities and of the styrene plants to balance the program upwards so that the maximum possible amount of Buna S might be produced in 1943. If this expectation and the optimistic estimates of the present schedule are realized, the Buna S produced in 1943 might be as much as 450,000 tons. Even this amount will not provide too large a margin of safety when it is recalled that our "carryover" to 1944, assuming only a 400,000 ton Buna-S production, does not exceed 100,000 tons.

LOOKING AHEAD TO 1944

The present plans call for the building of polymerization plants with a rated output of 705,000 tons of Buna S. If the 100,000 short tons of butadiene (equivalent to 110,000 tons of Buna S) provided by the refinery conversion program are to be utilized when the program is complete, additional facilities for polymerization must be provided and likewise for the manufacture of styrene. While there is evidence that the butadiene plants may produce 15 percent to 20 percent above their rated capacity our experts have found no indication that a similar situation exists with respect to the polymerization plants.

The WPB has fixed the total annual output of Buna S at 705,000 tons. The Committee recommends that this figure be raised now by 140,000 tons, and that this be accomplished by authorizing (a) the construction of the additional polymerization facilities and styrene capacity, to be ready by Jan. 1, 1944, which are required to balance upwards the annual production of the refinery conversion program (110,000 tons of Buna S); and (b) the later construction of a 27,000 ton butadiene plant and a 30,000 ton polymerization plant to be located near the center of grain production. The Committee recommends that the Rubber Administrator, about six months hence in the light of the situation which exists regarding the best technical process then proven for the production of butadiene from grain, and in the light of the need for additional Buna S which may then be estimated, proceed with the erection of the 27,000 ton butadiene plant from grain and the associated polymerization plant. He should also make whatever arrangements are necessary to produce and ship the necessary styrene from the centers of styrene production. If the needs for synthetic rubber and the production program are in balance, making due allowances for civilian driving, he may then cancel the erection of this additional 30,000 tons of Buna-S capacity.

The Secretary of Agriculture has assured the Committee that no concern need be felt that the expansion of the butadiene from grain program will interfere with our food supplies. After all food requirements that can be anticipated have been met there will be upwards of 1,250,000,000 bushels of wheat left in this country.

This additional Buna S, which it will be thus possible to produce in 1944, should provide the margin required for relaxing the restrictions on civilian driving. As we have pointed out earlier in this report, if by the end of 1943 the synthetic rubber manufacture is in satisfactory shape and the military needs for rubber have not increased, it should be possible to allocate considerable quantities of Buna S for civilian needs. We shall not need the 140,000 extra tons of Buna S until 1944, when it will be required for tires for passenger cars. Without at least half this amount in that year, a great many passenger cars would be forced off the road; for it is at that time that we shall have to begin to repay the rubber which we have been borrowing so to speak, by running our cars without a tire replacement and recapping program during the past eight months.

EXTRA POLYMERIZATION FACILITIES

By delaying the construction of the extra polymerization facilities for six months we shall in all probability prevent a serious conflict between this eventual expansion of the Buna-S program and other aspects of the war program. There is every reason to believe that the shortage of critical materials will be less acute six to eight months from now, and this will certainly be true in regard to facilities for fabricating special chemical equipment.

Our recommendation for additional 27,000 tons of butadiene capacity to be located near the center of grain production is made with this time schedule in mind. This plant (together with the corresponding 30,000 ton Buna-S plant) need not be started for another six months. There will be relatively little cost to the war effort involved in its construction for the reasons just given in regard to the easing of the situation in respect to the fabrication of equipment. Furthermore, another advantage will accrue. At that time—six months hence—it will be possible to judge the relative merits of two processes for the manufacture of butadiene from grain which are not now in the Government program, namely, the Publicker process using alcohol and that employing butylene glycol developed by the Department of Agriculture in Peoria. This latter method involves a special fermentation of grain. These two processes should be carefully compared with the alcohol process developed by the Carbide and Carbon Chemical Corp., and now a major part of the government's plans. At present insufficient data are at hand for an evaluation. A few months from now this will no longer be the case.

ALCOHOL FROM GRAIN

It is clear to the Committee that new facilities for producing alcohol from grain must be provided. More alcohol may be required for the production of butadiene in plants under construction, if not, the extra capacity will be useful in the explosives program. The estimates we have obtained from the most reliable sources vary, but in all likelihood a considerable quantity of additional alcohol must be on hand in 1943 and 1944 to meet both the synthetic rubber and the explosives program. We recommend that these facilities be erected on a site near the grain producing states and located on water transportation. By the use of recently developed apparatus, alcohol plants can be constructed with little expenditure of critical materials.

If the Rubber Administrator should decide that the plants for the production of the additional 30,000 tons of Buna S which we recommend should be constructed during late 1943, they should be located near the center of grain production and such units should if possible be operated under the control of an independent local group. Diversification of the synthetic rubber industry both from the point of view of geography and control seems important to the Committee. Another element in the competition would be provided if this recommendation is carried out.

We may sum up our recommendations in respect to the Buna-S program as follows:

(1) There should be no further changes in the plans now laid for the construction of the scheduled plants—the time to freeze has passed in view of the urgency of 1943.
(2) The authorization of an additional 140,000 tons of Buna-S capacity per year.
(3) Proceed immediately with a conversion of refinery plants to pro-

duce a total of 100,000 tons of butadiene by this process, this being in addition to the butadiene now planned from other processes in the present program.

(4) Promptly make an adjustment in the construction rates of the present styrene and polymerization plants, in order that the maximum amount of Buna S may be produced in 1943.

(5) Expand the polymerization and styrene facilties to be ready on Jan. 1, 1944, to balance upwards the entire program.

(6) About six months hence, in the light of the situation which then exists regarding the best technical processes then proven for the production of butadiene from grain, and in the light of the need for additional Buna S rubber which may then be estimated, proceed as indicated with the erection of a plant to produce an additional 27,000 tons of butadiene from grain through alcohol or butylene glycol and with the erection of an associated additional polymerization plant to produce 30,000 tons of Buna S, both to be located near the center of grain production. Also make whatever arrangements are necessary to produce and ship the necessary styrene from the centers of styrene production.

(7) Proceed promptly with the erection of an alcohol plant to produce 100,000,000 gal. of alcohol per year, by the use of recently developed apparatus. This plant could be erected on a site near the grain producing states and located on water transportation.

Finally, as a further margin of safety, considered only from the point of view of filling military needs, *we recommend the construction of an additional plant for the production of neoprene to the extent of* 20,000 *tons a year capacity. We make this recommendation because* neoprene is the one synthetic material of a quality to be the full equivalent of natural rubber for combat and heavy duty tires, either by itself or in combination with Buna S.

MATERIALS OF CONSTRUCTION

The relatively high cost of this substance in terms of critical materials required for the construction of the plant and electric power need is offset by its special significance in the rubber program. As an insurance against the distant possibility that we may be cut off from all supplies of natural rubber, we feel that the expenditure involved to provide an additional margin of safety is not too great.

Four large rubber companies already have developed their own polymerization facilties, each one differing somewhat from the others. Each represents the best efforts of a separate group of keen technical men. Last May, Rubber Reserve decided to standardize all the new polymerization plants which were to be constructed; this means, in essence, also standardizing the operation.

The design that is now ready is a compromise of the ideas of four separate technical groups. It may or may not incorporate the best ideas of each; on this point grave doubts have been expressed to the Committee. At all events, no one has ever operated such a standardized plant. The need for the immediate construction of one such standard plant so that experience with its operation can be obtained at the earliest moment is evident. It is our recommendation, therefore, that one of the standard plants now on the schedule be rushed to completion as quickly as possible.

OPERATION OF POLYMERIZATION PLANTS

The recognition of the importance of technological competition leads us to make two recommendations in regard to the operation of the polymerization plants:

First, one or more corporations controlled by the smaller rubber companies and chemical companies interested in polymerization should operate a certain number of these standard plants.

Second, at the same time, to keep the competitive urge to improve the new art of polymerization, we recommend that as part of the program each of the four large rubber companies be allowed to expand their facilities according to *their own design*, if they so prefer. We feel sure that the pride of authorship, as strong among technical men as among artists, under these conditions will yield in a short time a rich harvest to the Nation. Adoption of this second recommendation would not retard the program, for the expansion should be provided in that portion of the program we have recommended which requires additional polymerization facilties to be ready about Jan. 1, 1944, to balance the refinery conversion program.

The Nation as a whole is endeavoring to provide for the development of essentially novel manufacturing operations on a vast scale. How this program is managed and the spirit in which it is carried forward seem to us of great significance. Unlike the production of ammunition, the enterprise has implications for the postwar period. For a double reason, therefore, the Nation is concerned lest special groups play too large a part in the construction and operation. For the rapid development of the new art this Committee is fearful lest the influence of governmental policy serve to discourage the beneficial rivalries of the best brains in industry. We believe, therefore, that on the one hand there should be complete interchange of information and, on the other, as much competition in research, development and operation as possible. Such, after all, are the conditions applying in the field of laboratory science where during the last hundred years tremendous strides have been made. Competition and cooperation in this new national effort we believe, should go hand in hand.

In concluding this section of the report which deals with the synthetic program, the Committee wishes to make special mention of the fact that there are a number of materials in the offing which give promise of considerable significance in the future development of rubber substitutes.

In particular, flexon, which is very similar to butyl rubber, is now undergoing careful tests to determine its utility in the manufacture of tires and as a recapping material. Flexon has an advantage over butyl rubber, in that it can be made more quickly and the plant involved does not require any large amount of critical materials.

The production would be limited, however, by the amount of solid carbon dioxide (dry ice) that would be available. The process is a wasteful one from the point of view of isobutylene, a raw material which is also of great value to the aviation gasoline program. As the tests of flexon stand today, the Committee does not feel that it can recommend the inclusion of any large production in the present program. However, in the course of a relatively short time the art of manufacture may be improved and one of the chief present drawbacks, namely, the lack of uniformity in different samples, may be overcome. If later tests prove the usefulness of this substance, its production then could be undertaken in considerable quantities.

OTHER RUBBER SUBSTITUTES

Another rubber substitute which we are not recommending in our program but which is nevertheless in an interesting state of development is the material known as "noropol", prepared by a series of chemical reactions from soya bean oil. The process of manufacture seems entirely feasible, but the tests have not yet gone far enough to demonstrate the worth of the material in the manufacture of tires or recaps. It will undoubtedly have value as a substitute for rubber in certain mechanical goods.

Several other developments of a similar nature have been called to the Committee's attention, but all are as yet in the laboratory stage. The Committee hopes that experimentation will continue and facilities be provided so that these new substances which show real promise may be tested thoroughly and eventually find their proper place in the national economy. Necessity requires the country to stop tampering with the present synthetic rubber program in order to produce the maximum amount of usable material in the coming year. It would nevertheless be most unfortunate if this situation should prevent the development of other materials or new methods of manufacture.

Saving Drafting Time With "Dizzy Diagrammatics"

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Chem. & Met. INTERPRETATION

This, in the recollection of *Chem. & Met's* staff, is the first paper on the mechanics of drafting ever published in this magazine. As such it had to have a special significance to the chemical industry. Our author's "Dizzy Diagrammatics" is nowhere nearly as dizzy as the name suggests, nor as a first glance at a drawing so produced would indicate. The first glance may be startling, but once the engineer has tried out the system for himself, he will begin to see how its use can save some 30 percent of drafting time on a complete plant lay-out design, and still gain results in clear portrayal that are impossible with conventional drafting methods.—*Editors.*

"DIZZY DIAGRAMMATICS" is a simplified method of plant lay-out design which I, and those under my supervision, have been using quite successfully for the past few years. It is a diagrammatic arrangement showing clearly and specifying completely each piece of equipment, valve, fitting, control, and so on. Each piece of equipment, run of pipe, etc., is shown in its true relative position although in some cases the run of pipe is foreshortened or lengthened to avoid unnecessary confusion.

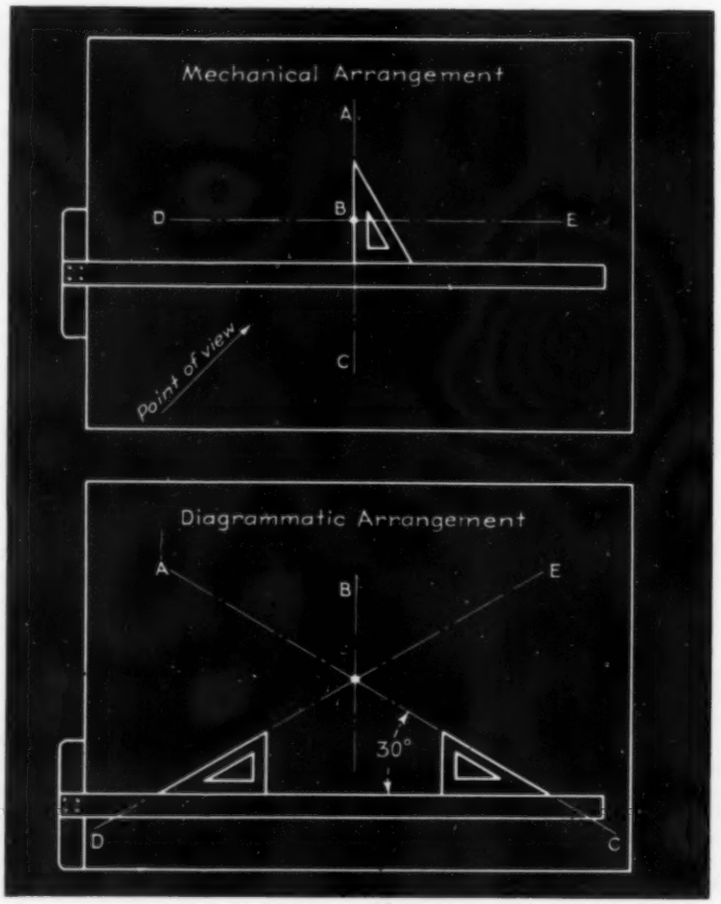
Considerable opposition and criticism of this type of drawing arose before it was officially accepted. Prior to its development our usual design procedure had been a mechanical arrangement drawing, locating and specifying each piece of equipment. This mechanical arrangement drawing actually consisted of three separate tracings, each 30x42 in., including one sheet of plans, one of elevations, and one of sections. Approximately 60 man-hours of work was required for each. In addition, these drawings were traced over, the equipment shown in light lines and the piping, valves, controls, etc., drawn in and specified. These tracings each required another 50 man-hours.

We found that it was possible to save 100 man-hours on each contract (each such set of drawings) by using the new diagrammatic arrangement in place of the three piping drawings, and by adding the larger and more important piping to the mechanical arrangement and naming but not specifying this equipment. Not enough was added to the mechanical arrangement to make it confusing. Needless to say, this large time saving overcame all opposition to the method.

During the last three years when millions of dollars worth of defense work has been designed, the economy of this type of drawing has been definitely proven. No time study has been made of these defense contracts but I venture the opinion that the savings have been several thousand dollars. The saving in time alone has been great enough to warrant the adoption of this method by engineering concerns.

Our engineering design division is not the only department which benefits from this type of drawing. The young men and women in the pro-

Fig. 1—Illustrating the principle of "Dizzy Diagrammatics," by comparing the mechanical arrangement with the diagrammatic method



curement department, several of whom cannot read complicated piping drawings, have found these diagrammatic arrangement drawings a wonderful help. To them this type of drawing is a complete bill-of-material from which they can easily pick each item to be ordered.

Then, in the field, the construction superintendent uses this diagrammatic as a construction manual. From it he can readily point out to his foremen and mechanics the various runs of pipe, fittings, valves and controls. It gives the mechanic who cannot read blueprints a complete photographic picture of the plant as a whole, enabling him to work more intelligently at his own particular job.

Finally, the operating manager, handicapped as he often is at present by inexperienced operators, uses this diagrammatic as a flowsheet, by coloring each pipe line, valve and control shown on the blueprint with a distinctive color, and adding a color key. The print, thus colored, can be pasted on the wall of the operating room where an inexperienced operator can readily trace the different pipe lines and locate the control valves. This has saved many an expensive shut-down.

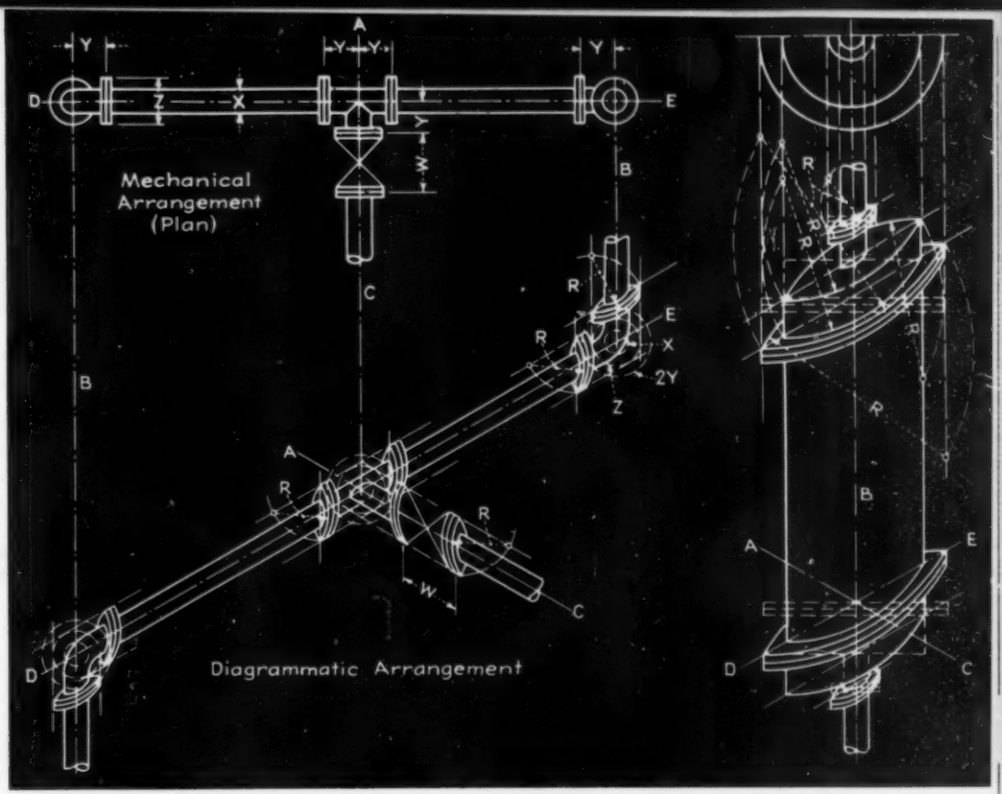


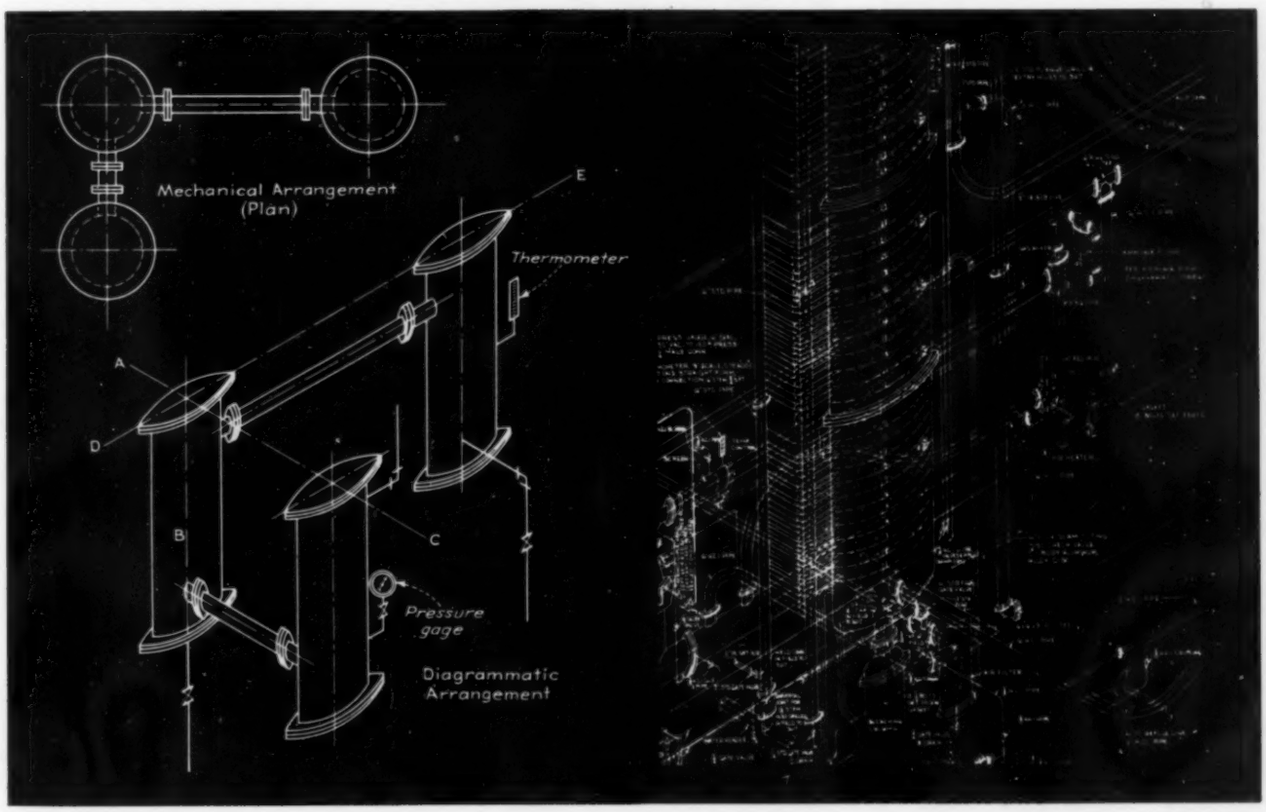
Fig. 2—Diagrammatic method applied to drawing of a simple pipe layout

Fig. 3—Cylindrical vessel is drawn by tracing over an elevation view

The several drawings reproduced here will give a general idea of the diagrammatic as well as the method I have developed to expedite this type of drafting. Diagrammatics resemble isometrics although they do not involve all the laborious and tedious projection. They are much easier to read and are as accurate and more complete for their purpose. When the few fundamental principles are better understood by the average draftsman I believe the system will be more commonly used and will re-

Fig. 4—The vessels are drawn as in Fig. 3, but the pipes are lengthened proportionately to spread the equipment

Fig. 5—Portion of an actual diagrammatic which cannot be shown in full, but illustrates clarity of the method



sult in a considerable saving of time and a relative increase in engineering production.

The basic principle of this method is illustrated in Fig. 1. The point of view is optional and may be from the lower left hand or right hand side of the mechanical arrangement. The lower left hand has been found to be the most satisfactory and is used in the following description. In Fig. 1. Point *B* represents any vertical riser or center line on the mechanical arrangement. Line *AC* is any line running from the top of the drawing to the bottom, and line *DE*, any line running from left to right. The corresponding lines are indicated on the diagrammatic arrangement and are at an angle of 30 deg. to the horizontal.

How to apply this principle and the system used for rapid drawing of the diagrammatics are illustrated in Fig. 2. Here the circle *2Y* is drawn with a radius equal to the dimension *Y*, the center-to-face of fittings. This circle may have to be increased at times to avoid interferences of flanges. Circle *Z* is drawn equal to the diameter of the flange of the fitting or apparatus. Circle *X* has as its diameter that of the pipe or apparatus. Parallel lines are drawn tangent to these circles as shown by the dashed lines and are used as construction lines for the diagrammatic, later to be erased from the finished tracing. Radius *R* is the projected diameter of the flanges. All center lines are identified as in Fig. 1.

A mechanical arrangement drawn to a scale of ½ in. to the foot is the most satisfactory size from which to reproduce the diagrammatic. Dummies of the equipment can be cut from a print of the elevations or sections and pasted on a piece of drawing paper in a position which corresponds to their respective locations on the mechanical arrangement. These dummies should be located in such a way that each piece of equipment will be shown clearly. In some cases this will mean increasing the center to center distance of the equipment along lines *AC* or *DE*. For example, Fig. 4 shows how the equipment may be spread to portray each piece plainly and yet retain its relative position.

In Fig. 3 is shown the method of transferring the dummies from the mechanical to the projected view of the diagrammatic. The light dashed lines would not be used in an actual drawing but here represent the dummy visible through the tracing. The projected diagrammatic itself is shown in heavy lines. It will be obvious that the principles are the same as those described for Fig. 2. The letters are also the same.

A general idea of what may be accomplished by this system of drawing is suggested by Fig. 5. Unfortunately the secret nature of this work prevents the reproduction of the full 30x42 in. diagrammatic arrangement of this complete plant.

No attempt should be made to project such items as gages and thermometers, which can be shown as in Fig. 4. This figure also shows how pipe, valves and fittings under 2 in. can be drawn as a single line. The quickest way to acquire facility in this method is to use it. The draftsman will, of course, develop habits and variations of his own which will increase his versatility and his ability to accomplish more with this time-saving system.

Heat Balance Equations for Multiple-Effect Evaporators

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Chem. & Met. INTERPRETATION

In calculating the heat transfer area required for a particular multiple-effect evaporator installation, it is necessary to know the heat balance equation applying to the installation. Several cases are possible, and different equations result when the method of feeding the evaporator, and the feed temperature, are varied. In books which describe the derivation of the equations, the method is fairly complex, while in other books the equations may be omitted entirely, or the derivations may not be given. The article below shows a simplified method of setting up these equations.—*Editors.*

In MULTIPLE-EFFECT evaporator design calculations, the most important quantity to be calculated is the heat transfer area. The heat transfer area is calculated by the simultaneous solution of three equations: (1) The heat balance equation, (2) the heat transfer rate equation, and (3) the capacity equation.

The heat balance equation to be used depends upon the method of feeding the evaporator, and upon the temperature of the dilute feed. There are four different methods of feeding, and the dilute feed may enter the evaporator at a temperature which may, or may not, require preheating in the effect which it enters. In the latter case, the feed may, or may not, flash. There are, therefore, several combinations of conditions possible. The heat balance equations for all these cases are given below. They are based upon the assumption that the radiation losses are negligible. The correction for the radiation losses is made after the heat transfer area calculations are completed.

Evaporators may be fed in the direction of decreasing pressure drop, with the new feed entering the first effect and passing thence to the second, third and later effects, if any. This is known as forward feeding. Or the feed may first enter the last effect, in which the pressure is lowest, and flow forward through each earlier effect to the first, which is known as backward feeding. Mixed feeding is the procedure where the new feed enters some other effect than the first or last. There are various methods of mixed feed depending on the requirements, a common method in the case of a quadruple-effect evaporator being to introduce the new feed in the second effect, from which it flows in turn to the third, fourth, and finally to the first.

The derivation of the heat balance equations for the forward and backward feeding of multiple-effect evaporators is given by Badger[1]. The method, however, could be simplified, and it is the purpose of this paper to do so. Other standard text books

on evaporation[3] or on chemical engineering [2] either do not give the heat balance equations, or if they do, they do not show the derivation.

To illustrate the derivation of the heat balance equations for each of the four methods of feeding (and for the several possible variations of each method depending on the feed temperature), it will be necessary to take only two cases in detail. However, the equations for all other cases will be given below. The methods employed for the detailed cases can easily be applied to the others.

Let L=the latent heat af evaporation, in B.t.u. per pound; Q=the quantity of heat transferred through the heating tubes to the liquid in each effect, in B.t.u. per hour; q=the heat required to raise the temperature of the feed in a particular effect to the temperature of the boiling liquid in that effect, in B.t.u. per hour; and S=the weight of liquid flashed into vapor in the effect, in pounds per hour. In the following, these terms are used with subscripts which refer to the effect number. All equations are based on the heat transferred in and out of each effect in a period of 1 hour.

Case 1, Forward Feed

(*a*) The dilute feed enters the evaporator "cold". It must therefore be preheated in the first effect. In all other effects the feed liquor will flash. Fig. 1 shows the four effects, with a heat balance written for each effect. The heat balance is solved for $Q_1 - q_1$, and for n effects, as follows:

$$\begin{aligned} Q_1 - q_1 &= Q_2 = Q_3 - S_2L_2 \\ &= Q_4 - (S_2L_2 + S_3L_3) = \ . \ . \ . \\ &= Q_n - (S_2L_2 + \ . \ . \ . \ + S_{n-1}L_{n-1}) \end{aligned}$$

(*b*) The dilute feed enters the evaporator at such a temperature that no preheating in the first effect is required. However, the temperature is not high enough to make it flash. In all the other effects the feed liquor flashes. Here the equation is:

$$\begin{aligned} Q_1 &= Q_2 = Q_3 - S_2L_2 = Q_4 \\ &- (S_2L_2 + S_3L_3) = \ . \ . \ . \ = Q_n \\ &- (S_2L_2 + S_3L_3 + \ . \ . \ . \ + S_{n-1}L_{n-1}) \end{aligned}$$

(*c*) The dilute feed enters the evaporator at such a temperature that it flashes in the first effect. Likewise, in all the other effects the feed liquor flashes, so that the equation is:

$$\begin{aligned} Q_1 + S_1L_1 &= Q_2 = Q_3 - S_2L_2 = Q_4 \\ &- (S_2L_2 + S_3L_3) = \ . \ . \ . \ = Q_n \\ &- (S_2L_2 + S_3L_3 + \ . \ . \ . \ + S_{n-1}L_{n-1}) \end{aligned}$$

Case 2, Backward Feed

(*a*) The dilute feed enters the evaporator "cold". Hence, it must be preheated in the last effect. Likewise, in all the other effects the feed liquor must be preheated. This particular case is illustrated in Fig. 2. As in Case 1 (*a*), a heat balance is made for the individual effects. Then solving for $Q_4 - q_4$,

$$\begin{aligned} Q_4 - q_4 &= (Q_1 - q_1 - q_2) - q_3 - q_4 \\ &= (Q_1 - q_1) - q_2 - q_3 - q_4 \\ &= (Q_1 - q_1 - q_2 - q_3) - q_4 \end{aligned}$$

Therefore,

$$\begin{aligned} Q_4 - q_4 &= Q_3 - (q_3 + q_4) = Q_2 \\ &- (q_2 + q_3 + q_4) = Q_1 \\ &- (q_1 + q_2 + q_3 + q_4) \end{aligned}$$

and for n effects,

$$\begin{aligned} Q_1 - (q_1 + q_2 + \ . \ . \ . \ + q_n) &= Q_2 \\ - (q_2 + q_3 + \ . \ . \ . \ + q_n) &= Q_3 \\ - (q_3 + q_4 + \ . \ . \ . \ + q_n) &= \ . \ . \ . \\ = Q_n - q_n \end{aligned}$$

(*b*) The dilute feed enters the evaporator at such a temperature that it flashes in the last effect. In all the other effects, the feed liquor must be preheated. The equation here is the same as in the preceding case.

Case 3, Mixed Feed

Assume a quadruple-effect evaporator with three effects forward.

(*a*) The dilute feed enters the evaporator "cold". Hence it must be preheated in the second effect. The feed liquor flashes in the third and fourth effects. It then moves backward to the first effect where it must be preheated. The equation is:

$$\begin{aligned} Q_1 - q_1 &= Q_2 = Q_3 + q_2 = Q_4 + q_2 \\ &- S_2L_2 \end{aligned}$$

(*b*) The dilute feed enters the evaporator at such a temperture that no preheating in the second effect is required. However, the temperature is not high enough to make it flash. The feed liquor flashes in the third and fourth effects. It then moves backward to the first effect where it must be preheated, so that:

$$Q_1 - q_1 = Q_2 = Q_3 = Q_4 - S_2L_2$$

(*c*) The dilute feed enters the evaporator at such a temperature that it flashes in the second effect. Likewise the feed liquor flashes in the third and fourth effects. It then moves backward to the first effect where it must be preheated, giving the heat balance equation:

$$\begin{aligned} Q_1 - q_1 &= Q_2 = Q_3 - S_2L_2 = Q_4 \\ &- (S_2L_2 + S_3L_3) \end{aligned}$$

Case 4, Parallel Feed

(*a*) The dilute feed is at a temperature which is below the temperature in the last effect. Hence, it must be preheated in all the effects, and:

$$\begin{aligned} Q_1 - q_1 &= Q_2 = Q_3 + q_2 = Q_4 \\ &+ (q_3 + q_2) = \ . \ . \ . \ . \ = Q_n \\ &+ (q_{n-1} + \ . \ . \ . \ + q_2) \end{aligned}$$

(*b*) The dilute feed is at such a temperature that it must be preheated in some of the effects, e.g., in the first and second, and it flashes in all the others. Hence:

$$\begin{aligned} Q_1 - q_1 &= Q_2 = Q_3 + q_2 = Q_4 + q_2 \\ &- S_3L_3 = Q_5 + q_3 - (S_4L_4 + S_3L_3) \\ &= \ . \ . \ . \ = Q_n + q_2 - (S_{n-1}I_{n-1} \\ &+ \ . \ . \ . \ + S_3L_3) \end{aligned}$$

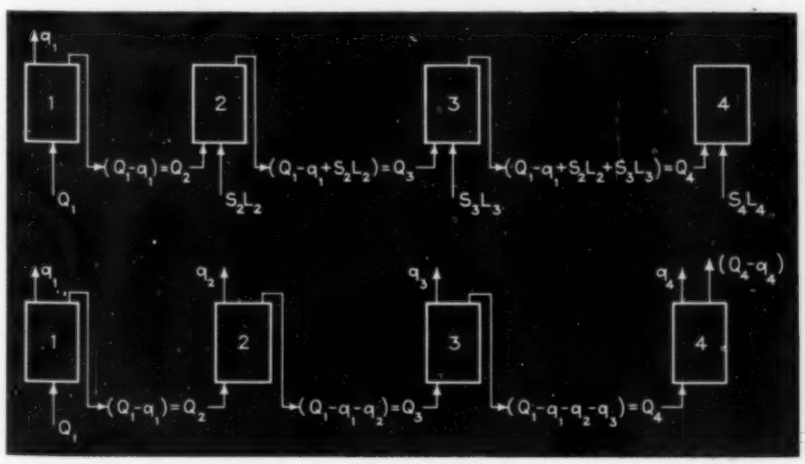
(*c*) The dilute feed is at such a temperature that it flashes in all the effects, and:

$$\begin{aligned} Q_1 + S_1L_1 &= Q_2 = Q_3 - S_2L_3 = Q_4 \\ &- (S_3L_3 + S_2I_2) = \ . \ . \ . \ = Q_n \\ &- (S_{n-1}L_{n-1} + \ . \ . \ . \ + S_2I_2) \end{aligned}$$

The terms in the above equations can be readily calculated on the basis of the definitions given.

Fig. 1—Heat balance on individual effects for forward feed. Case 1 (*a*)

Fig. 2—Heat balance on individual effects for backward feed. Case 2 (*a*)



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Waste-Salvage Program at Rahway

HOWARD STEPHENSON *American Industries Salvage Committee, New York*

Chem. & Met. INTERPRETATION

Programs for salvage are being instituted throughout the nation and chemical industries, too, are contributing scrap. Because good housekeeping is nothing new to the process industries it might be expected that their contribution would be relatively small. The error of this idea is shown by the impressive record which Merck & Co. made in their salvage campaign.—*Editors.*

TANKS, trench mortars, aerial bombs and machine guns are being contributed to the war effort by Merck & Co., manufacturing chemists of Rahway, N. J. Production of fine chemicals has not been stopped at the company. Merck is making its contribution in the form of salvaged waste. To date, an amount of critical materials sufficient to provide for the equipping of a sizable American task force has been sent to the salvage collector.

As R. E. Tandy, plant defense coordinator in charge of salvage operations states, there are other industries which could more than match their total poundage of scrap. But, as he will somewhat proudly tell you in the next breath, these are plants more or less engaged in the metals trades. Salvage possibilities which exist for them are denied to a chemical manufacturer. Nevertheless, salvage figures which represent a 1,000 percent increase over normal operations and show a total poundage to date of almost a million pounds are indicative of an outstanding job. The salvage campaign of the Merck organization is geared to make a definite contribution to the war effort.

The success of the company's salvage operations is due primarily to the sound organization of its campaign and to careful managerial supervision. When the need for salvaging critical materials became apparent, the management of the company early recognized the urgency of the War Production Board's request to get the nation's waste back into production at the mills and factories turning out war equipment. Response on the part of the officials to the salvaging job ahead was immediate and enthusiastic.

R. E. Tandy, given the responsibilty for organizing the campaign, quickly set about forming a salvage committee composed of one representative from each of the operating divisions of the company. The members of this committee were all hand picked with careful attention being given to their general reputations for getting things done.

Each of these committee members was asked to go through his division and select from each department men who would serve as salvage representatives were also men known to be alert and observing and who had the ability to "follow through." Plans for publicizing the campaign and for an immediate clean-up of the plant were formulated at a general organization meeting of the committee.

The results of the initial clean-up amazed even the men who supervised it. In three days they had accumulated 50,000 pounds of scrap iron, 20,000 pounds of scrap lead and substantial quantities of other critical materials. Particularly surprised was Mr. Tandy, for as he explains, housecleaning was not a new subject to the Merck company. For many years the company's plants have, in fact, been rather proud of their housekeeping methods. There is, however, a difference between collecting scrap for war and ordinary neatness routines. As they are quick to admit at Rahway, necessity sharpens the eye. Material and parts that had formerly been passed over many times took on a new significance when it could be translated into guns and plates for ships.

A central scrap area in the plant was set aside and plans formulated to arrange for a continuous scrap campaign.

A set of simple open bins at the central area was marked for the segregation of salvaged materials. Red, white and blue containers made from old barrels and drums were placed in strategic spots to serve as depositing places for scrap. Regular pick-up facilities were provided by the yard department which delivered

One of the scrap collection areas set aside at Merck to receive critical war materials salvaged by the company's scrap and waste collection program

the material to the centrally located bins.

Arrangements were made with a local junk dealer to have a weekly collection of all scrap with sales effective on a monthly basis at current market prices.

The publicizing of the program to the employees was accomplished through the education of the supervisors and with the use of posters, most of which are of the company's own design. One of the most successful of these is a kind of progress report of the collection of scrap metal and rubber, which translates the material already collected into the amount of weapons it will make. The imposing list of military equipment which was made possible as a result of their efforts proved a real morale booster for the workers. Their opinion seemed to be that if the waste they turned in could have that direct a bearing on the result of the war, they'd salvage metal for enough shells to raze Tokio.

Not satisfied with ordinary production and waste scrap, the officials of the company made careful inspection of all the buildings. They used a pretty good yardstick in deciding what to discard. Taking the position that if equipment hadn't been used for three months and if a use couldn't be proved for it in the next three, the equipment was eligible for resale or the scrap heap. They disposed of a number of pieces of unused equipment. Attention was given to the possibility of salvaging individual parts of such equipment with an eye to using them as replacements for machines in operations. An excellent haul in old radiators, dead pipe lines and other miscellaneous metal also rewarded their inspection.

To date, the salvage program at Merck has yielded the following amounts of critical materials: 640,292 lb. of iron, 3,213 lb. of aluminum, 1,656 lb. of brass, 6,883 lb. of copper, 78,061 lb. of lead, 5,200 lb. of rubber, 601 lb. of zinc and 25,130 burlap bags, a total of 761,036 pounds.

That such an active program of salvage and conservation must furnish benefits over and above putting the country's waste to work against the Axis is another fact turned up by the Merck campaign. As a result of examining all possibilities for conserving material, Mr. Tandy discovered that laundering mill ends and cotton gloves did more than conserve a considerable amount of cotton and wool. In the report which he sent to Mr. H. W. Johnstone, Vice-President of the company, he was able to advise that the procedure would save the company about $9,000 a year.

Despite the large quantities of scrap already turned in by the company, officials and workers alike are seeing to it that the salvage program remains active. Each day sees the exploration of some new possibilities, many of which produce new salvage opportunities. All of the organization's plants and branches have been set to work collecting with the idea of adding every available pound of scrap to the nation's stockpiles and they are operating their campaigns along the same lines as that of the main plant at Rahway.

Officials at Merck are willing to attribute some of their success in their salvage operations to efficient organization. Even more important, however, in their own minds and responsible for the efficiency with which they have conducted their program is the crucial situation of the steel mills in their dependence on scrap to keep the war going. As a result, they are keeping on their toes and letting no opportunity slip to add to their contribution of scrap for victory.

How Refineries Conserve Critical Materials

Chem. & Met. INTERPRETATION

In recent months the Office of the Petroleum Coordinator for War, through Max B. Miller, chief of the construction section of the refining division, has issued a number of booklets on "Wartime Plant Design", relating chiefly to the saving of strategic construction materials through materials substitutions in petroleum refineries. The article which follows is an editorial staff summary of several of these booklets, with the emphasis on those suggestions which are equally as applicable to other kinds of process plants.—*Editors.*

THE SUGGESTIONS given in the following have been abstracted from a group of letters from petroleum refineries and equipment manufacturers, received by the Office of the Petroleum Coordinator, and thereafter released to the refining industry.

Many suggestions were made which applied quite specifically to the petroleum industry. Among those more generally applicable were several suggestions made by the Atlantic Refining Co. This company is now ordering universal steel plates in place of sheared square-edge plates. All individual items of critical materials carried in stores are being examined to determine whether less critical materials can be substituted. Various salvage and reclaiming methods are being employed including the plating of chrome pump shafts for reconditioning and the salvaging of flanges which can be re-bored for use as slip-on welding flanges.

Among the suggestions made by the Babcock & Wilcox Co. is the one that two-drum boilers should be used as far as possible instead of multi-drum boilers. Steel casings are not essential for boiler units, even for outdoor plants, which can be covered with insulation and some form of nonmetallic casing material such as Transite.

Continental Oil Co. reports that in so far as possible all pumps are being designed for out-door installation and the use of standard motors where explosion-proof motors cannot be secured. These are installed in well-ventilated hoods for weather protection. Putting the pumps out-doors saves on building space. Layouts are being made as compact as possible to reduce piping and interconnecting lines to a minimum. Second-hand piping is being used for building framing and reclaimed sucker rods for reinforcing steel for concrete.

A variety of conservation suggestions has been made to its customers by Foster Wheeler Corp. For example, it is proposed to reduce manhole access steel, possibly providing only knee braces suitable for the maintenance crew to rig a wooden flooring. Ladders can usually be substituted for stairways, while fully floored and hand-railed platforms are necessary only for important operating levels. Reinforced concrete can be substituted for steel in many instances and glass blocks for metal

windows. Wood can be substituted for plate and grating trench covers and Transite or concrete for steel in large-sized water and sewer lines. Stacks can be built of concrete.

M. W. Kellogg Co. calls attention to the availability of pre-stressed reinforced concrete tanks in which the concrete is thrown into compression by pulling up horizontal steel circumferential rods in the reinforcing to a predetermined initial stress. This company has employed such tanks in diameters as large as 150 ft. and about 36 ft. high. Kellogg also points out that critical materials can be saved by easing bolting steel specifications which in the past have generally been unnecessarily high.

The Lummus Co., in addition to repeating some of the foregoing suggestions, mentioned the desirability of using treated wood flooring as a substitute for checker floor plates and gratings on many installations. Wood stave pipe is worth considering for above-ground water lines as a substitute for large cast iron and steel pipe.

Standard Oil Development Co. has developed a set of modified specifications granting contractors permission to deviate from regular material and equipment specifications under certain circumstances when the substitution will assist meeting schedules and will be satisfactory from an operating standpoint. For example, bessemer steel can be substituted for open hearth steel for certain purposes, including reinforcing rods, tank steel, condenser boxes, and stacks, as well as minor structural shapes, standard weight lapwelded pipe, floor plates, expanded metal and galvanized sheets. Narrower plates than standard may be used unless this use will so increase welding time as to cause delay in completion of the unit. For service below 800 deg. F., the new NE steels of recommended grade may be substituted for alloy steel bolting for high-pressure, high-temperature service.

The company has materially decreased its requirements for fusion-welded pressure and vacuum vessels, provided, however, that the vessels must still conform to the API-ASME code. The recommendations made at the WPB conference in Cleveland on March 31, 1942, have been adopted including the suggestion that where nickel and chromium are used to extend the life of equipment, the basis of design of new plants shall be an estimated three-year life, without requiring major repairs which might reduce the normal service factor more than 2 percent.

Many savings have been accepted in critical materials used in building structures. For example, the company is confining steel structures to those necessary for support of equipment, reducing steel usage for platforms and stairways to a minimum, using reinforced concrete for support of equipment wherever possible. Pipe lines which are normally provided for extreme operating flexibility or for possible future use are eliminated. Cocks are no longer being used on the discharge side of safety valves and in general the use of valves is being reduced to a point only sufficient to permit adequate hand control in the event of trouble with automatic control devices. The use of spare equipment for standby service is being minimized as is the application of control equipment.

Electrical controls for motors are being simplified and lighting minimized. Safety valves are being allowed to discharge directly into the air at sufficient height, where a hazard is not thus introduced. To a large extent cast iron valves and fittings are being substituted for steel for steam, refinery gas, refinery oil line, and water service, except in the more critical applications.

BUILDING MATERIALS

In building construction, permanent trolley systems for handling heavy equipment are being omitted and instead space is being provided for the access of crawler cranes or for temporary rigging. Some convenience platforms are being eliminated and others reduced in size. Reinforced concrete and wood are being employed wherever practicable instead of steel. For example, wood is being used as far as possible for stringers and treads of stairways, for ladders, railings, platform floorings and some framing. Massive concrete without reinforcement is being used where possible as in foundations and slabs on the ground, or with minimum reinforcement. As far as possible buildings are being constructed with brick walls, with wood roof beams or trusses, with plank roofs and built-up roofing. Wood is being used for door-frames, doors and sashes. An interesting idea for two-story structures is to use reinforced concrete for the lower story and heavy timber mill construction for the upper story.

A variety of other metal-saving suggestions has also been incorporated in the specifications including the use of cement-asbestos sheet material instead of galvanized and coated iron, the elimination of galvanized nails and metal lath, and the use of coated ferrous materials so far as possible without galvanizing for screening, flashing, and for down-spouts. Terra cotta and concrete are being substituted whenever possible for metal pipes for sewer lines, and non-metallic coated materials for conduits. Instead of conduits, non-metallic sheathed cables are being employed where practicable, together with electric light fixtures eliminating as much metal as possible. Cast iron, rather than copper, is being used for heating coils and convectors for inclosed areas.

Universal Oil Products Co. makes the interesting suggestion that steel can be saved by making the skirts of vessels very short, with the additional required height of the skirts supplied by reinforced concrete. This company claims that concrete pipe trenches with plate covers constitute a fire hazard and that pipes should therefore be buried or run overhead on concrete supports. Universal also suggests that plastic tubing can be used instead of copper for instrument airlines.

According to Standard Oil Co. of Ohio, important savings in alloy materials may be possible through the use of enamelled bubble caps. This company has reported on tests of such caps and has found them to give excellent results under severe operating conditions. For example, in one application cast iron caps lasted only six months but the enamelled caps now used have not required any replacements in more than a year.

A possibility for eliminating a serious bottleneck in large equipment fabrication capacity was suggested by Sinclair Refining Co. Since there appears to be an impending shortage of capacity in stress-relieving furnaces, this company has suggested permitting the construction of towers in sections so that a complete ring with its bubble trays, downcomers and other internal parts can be stress-relieved and shipped as soon as completed, thus permitting field erection and welding of the sections as they are delivered. A tower manufacturer has stated that if all purchasers placing business in his shop accepted towers in sections, production could be increased from 250 to 350 percent.

Along the same line is the idea that it may be possible, through consultation with equipment manufacturers before designs are completed, to effect other changes in design which would greatly increase equipment production capacity without seriously interfering with the installation or the efficiency of the equipment.

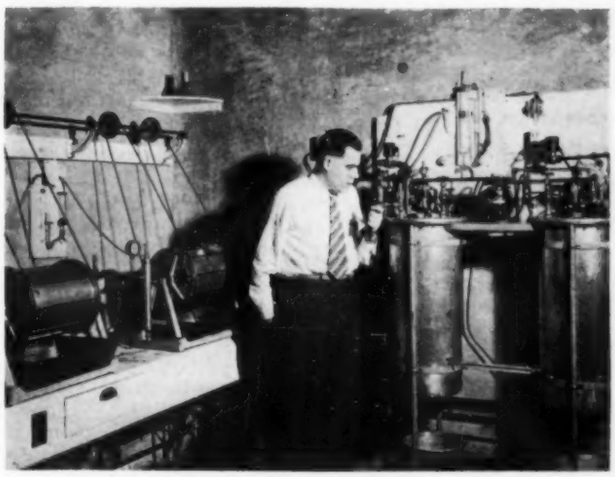
Butylene Glycol from Corn by Fermentation

A SHORT AND economical process for making butylene glycol was recently announced by the U. S. Department of Agriculture. The new method, developed at the Northern Regional Research Laboratory at Peoria, Ill., involves fermentation of farm crops such as corn and wheat. The laboratory is now producing butylene glycol on a pilot plant scale.

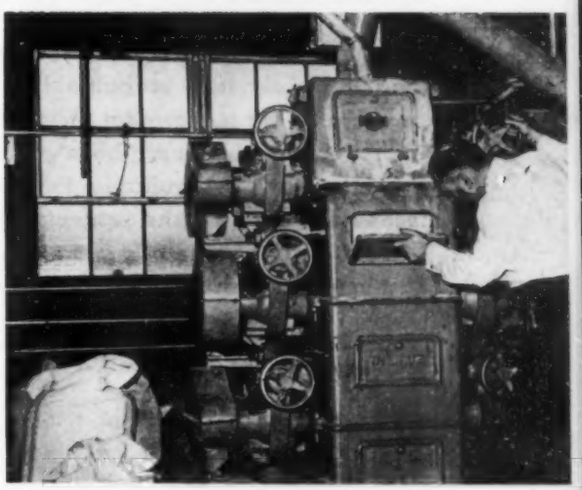
A study is being made of butylene glycol as a possible link in the production of butadiene for synthetic rubber. Three steps would be involved: (1) raw material to butylene glycol, (2) butylene glycol to butadiene, and (3) butadiene to synthetic rubber.

The major problem is conversion of the glycol to butadiene on a commercial scale. Chemists at the Peoria laboratory have succeeded in producing excellent yields of pure butadiene from corn-made butylene glycol in the laboratory, but they have not as yet developed the process to a pilot plant scale. Several industrial concerns are now producing butylene glycol on a pilot plant scale as a result of information developed in the Peoria laboratory. All illustrations on this page are from the U. S. Department of Agriculture, photographed by Forsythe.

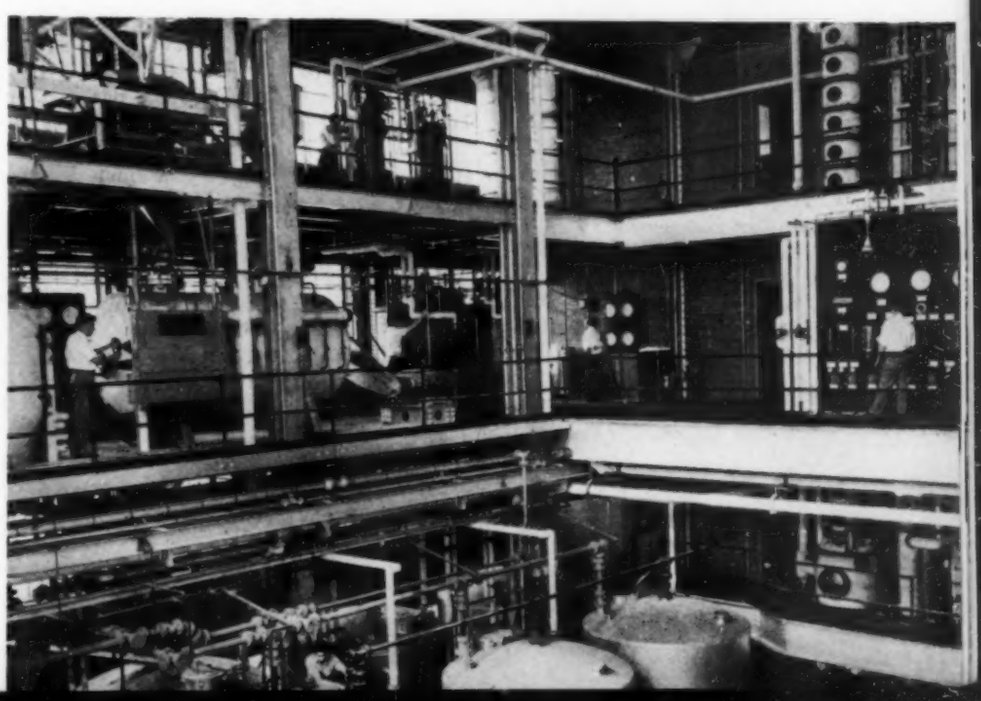
Butylene glycol is recovered from corn fermentation liquors in this experimental still in the pilot plant of the Northern Regional Research Laboratory, Peoria, Ill. Butadiene can be made from the glycol



One of the experimental fermentation vats for conversion of corn to butylene glycol, from which excellent yields of pure butadiene have been made on a laboratory basis



Checking the milling of corn for experimental use in bacterial fermentation to butylene glycol by the new process



View of the pilot plant set up by the Dept. of Agriculture at Peoria, Ill. to test new processes for making industrial alcohol from fermentable farm products

Uses and Properties of Acidproof Cements

JOHN H. S. BARR
Pennsylvania Salt Mfg. Co.
Philadelphia, Pa.

Pointing joints with Asplit resin cement in a pulp treating tank

Chem. & Met. INTERPRETATION

Although ceramicware linings are by no means unusual in chemical industry work, it is probable that their use will be considerably accelerated by the present stringency in metals. Furthermore, the improvements that have been made in recent years in the various cements that are available for bonding such linings, and in the techniques of using the cements, singly and in combination, make this article of particularly timely interest. The author includes data on temperature drops through various lining constructions.—*Editors.*

ACIDPROOF CEMENTS used in construction work to combat corrosive liquids and gases are generally of three varieties—the sulphur, sodium silicate and resin types.

The first, sulphur cements, consist mainly of crystalline sulphur which may or may not have other materials such as silica, carbon or synthetic rubber added to improve the physical characteristics. Such cements are applied by melting and pouring into open joints between the bricks. The material must remain liquid until all of the joint spaces have been filled, so it is always necessary to have joints of appreciable width to provide a volume of hot sulphur sufficient to keep the cooler bricks from causing the cement to solidify. Also it is necessary to provide seals across the surface joints to retain the molten cement until it has solidified.

Sulphur cements adhere quite well to acidproof bricks and also to membraneous materials such as rubber and asphalt. As a rule they are not allowed to come into direct contact with either metals or concrete. Most types shrink upon solidification and, therefore, must be poured a little at a time to compensate for the shrinkage.

Since sulphur cements are combustible, they must be kept from open flames. They are unaffected by water and many acids, but are attacked by some acid conditions which are not harmful to ceramicware. When a sulphur cement contains carbon but no silica, it is not attacked by hydrofluoric acid. Ceramicware, because it contains appreciable quantities of silica, can not withstand HF. Structural carbon is used most extensively for hydrofluoric acid service. Sulphur cements have a linear expansion coefficient of 0.0000083 per deg. F., whereas the coefficient for acidproof brick lining laid in sulphur cement is 0.0000043 (Payne and Duecker, *Chem. & Met.*, Dec. 1939, p. 768).

Since thin joints are not used with sulphur cements, exact sizes and shapes of ceramicware pieces are not required and the installation of acidproof brick linings does not require skilled bricklayers. Sulphur cements when carefully handled may be relatively dense. This presents an advantage as a protection against infiltration of liquids, but is disadvantageous in service where there are temperature variations.

Most of the sulphur cements melt at about 235 deg. F. and since the crystalline structure of sulphur changes and the coefficient of thermal expansion usually increases at about 200 deg. (Payne and Duecker, *Chem. & Met.*, Jan. 1940, p. 20), it is advisable not to use sulphur cements in equipment which will be operated at temperatures above approximately 195 deg. F. It is necessary to make provision for expansion of linings which are of appreciable length. It has been noticed in some cases that the sulphur cements grow continuously after long periods in intermittent hot and cold service. This tendency to grow will, in the course of time, weaken the bond of the crystal structure of the sulphur cement.

SODIUM SILICATE CEMENTS

Sodium silicate cements have been used for many years as a bonding material for chemical ceramicware. They are not readily adaptable for use as a coating material in sizeable areas, but are used principally as a mortar to butter bricks.

Sodium silicate is manufactured in both liquid and powder forms. For acidproof cements, the siliceous powder is usually (but not always) mixed with sodium silicate solution. In refractory cements, however, solid sodium silicate is usually combined with the silica powder and the cement is mixed on the job with water to form a mortar. Acidproof cements which contain solid sodium silicate are relatively expensive. Also they must be packed in tight containers so that they can absorb neither water nor carbon dioxide. When freshly made they react like cements mixed with sodium silicate solution (although they set a little slower),

but if the powder has been allowed to absorb water or CO_2 from the air during storage the final mortar will not have great mechanical strength. These cements do not shrink as much as those made with waterglass solution and in some instances successful small castings have been made from them.

The early sodium silicate cements consisted solely of ground quartz or sand which was mixed to the proper consistency with sodium silicate solution. The mixture was able to set up either by the removal of water alone, or by the reaction of the sodium silicate (usually with an acid) and the subsequent removal of the water. When such a cement solidifies by the reaction of the sodium silicate, the silicate is precipitated as silica and forms a bond, which is no longer soluble in water or in any acid with the exception of hydrofluoric acid. However, if the cement solidifies only by the removal of water, it may be redissolved by subsequent addition of water.

SILICATE CEMENT PROPERTIES

The water in sodium silicate mortars does not react chemically in either of type of hardening, so that when the water is removed, the cement tends to shrink and become porous. This is the principal reason why sodium silicate cements are not used as monolithic castings and coating materials. The porosity is an advantage in some cases, in that it provides a certain amount of elasticity to a ceramicware lining. For instance, the modulus of elasticity of a sodium silicate cement is about 800,000 lb. per sq. in., whereas that of concrete is usually taken at about 1,200,000 lb. per sq. in. However, porosity is a disadvantage if the lining is to contain solutions which infiltrate into the pores of the cement and subsequently crystallize. Many sulphates, for example, take on water of crystallization and expand when they crystallize.

Since the early sodium silicate cements required considerable time or treatment to become solid and since they were water soluble, unless reacted, their uses were limited to applications where time of completion was not a paramount requirement.

The time factor in sodium silicate cements was overcome only a relatively short time ago when the so-called self-hardening type was first patented in this country. Before that time the cements which contained no setting agents reacted too slowly and those which contained acid setting agents reacted too quickly.

These cements are unattacked by acids which do not contain free fluorine. They are most serviceable in acids of relatively high concentration. As a matter of fact, in the course of strong acid service such sodium silicate cements show material increases in strength.

The coefficient of thermal expansion of sodium silicate cements is of the same order as that of steel, namely, 0.0000063 per deg. F. This is the average value between 70 and 500 deg. F. which is the range of customary acidproof construction work.

Silica is, of course, a fairly good electrical insulator and under proper conditions these cements find service in electrical work. It must be remembered that they are porous, however, and unless dried out will retain some of the water from the mortar.

Brick linings should be used against an impervious shell. As a rule the sodium silicate mortar is buttered on to the bricks which are then squeezed into position inside the shell. The most nearly foolproof shell is a steel, rubber-lined tank, but in many cases concrete shells covered with an asphalt membrane have given many years of service. In other instances, ordinary welded steel shells which have been carefully lined with bricks have given their users very satisfactory service.

The joints between brick edges are usually kept as thin as possible—$\frac{1}{16}$ to $\frac{1}{8}$ in. The joints between the back of the brick and the shell are also kept rather thin, but since acidproof bricks are usually low in porosity (1 to 5 percent), and since there is no way for the water to be removed from the cement, there is no shrinkage in the setting of a self-hardening sodium silicate cement in the back joints. The cost per unit of volume of a good acidproof cement is more than that for a good grade of acidproof brick.

Acidproof bricks in manufacture are subjected to a careful process of vitrification which makes them substantially inert. Silicate cements, however, cannot usually be subjected to vitrification and, therefore, are apt to be more readily attacked than the bricks. This suggests another advantage of thin joints for acidproof brickwork, since the rate of washout of a thin joint is greatly reduced. One advantage in the use of such a mortar is that each brick is handled separately and the bricklayer knows definitely that there are no voids in the lining which might allow acid pockets to form during liquid operations. With molten cements, however, one complete horizontal course is usually laid at a time and the bricklayers cannot be certain that all of the voids in the joints have been filled.

CONSTRUCTION COSTS

When the bricks are handled by buttering with mortar, the shapes should be relatively uniform and the workmen should be trained and experienced in the work. Thus the labor costs of handling a mortar type cement are often higher than those for a molten type cement, but the material costs are lower because of thinner joints. The overall construction costs are practically balanced. Many industries where acidproof cements are used must have uninterrupted service and initial construction costs are not always paramount. For this reason the bricklayers who do this work are usually specially trained for it, and are impressed with the fact that the utmost care is necessary to be sure that the brick lining contains no voids.

Owing to water content in a sodium silicate cement, the final porosity of the joints is usually greater than

Workmen installing a two-course tank lining, using sodium silicate cement

that of molten cements, but some recently developed silicate cements have proven to be unusually dense. The finished lining consists of quite pure silica which will not be attacked by any acid conditions which do not contain free fluorine. Also the lining is resistant to any temperature conditions for which silica itself is suitable.

The great majority of acidproof brick linings are installed principally as a protection against temperature and abrasion. For instance sheet lead is resistant to a great many acid conditions, but when a lead lining is subjected to alternate heating and cooling it expands with increases in temperature. Thus the lead lining has a tendency to buckle and grow so that in the course of time the lead will crack. This trouble is often eliminated by the use of an acidproof brick lining inside the sheet lead. The brick lining has several purposes. In the first place it acts as a heat insulator; second, it keeps the lead in place; and third, it protects the lead from mechanical abuse. In acidproof construction work the sheet lead may be installed inside a shell of wood, concrete, steel, or other material. Thus the lead will act as an impervious membrane which makes the entire vessel liquid tight and corrosion-proof.

In some instances sheet lead is supported by a steel framework, and the temperature drop through acidproof brick lining is considerable, due to the fact that the lead surface is then free to radiate heat from most of its outside surface.

RUBBER LININGS

Rubber linings are also used quite extensively in corrosion resisting construction. The rubber is usually vulcanized to a sheet steel shell, but in some instances shells of wood or concrete lined with rubber have been used. A lining of this type is quite resistant to acid conditions but when subjected for prolonged periods to temperatures above 150 deg. F. tends to crack and disintegrate. Also the coefficient of thermal expansion of rubber is greater than that of most other materials used for acidproof construction. Rubber lined shells are quite often provided with an acidproof brick lining which serves not only to reduce the surface temperature of the rubber but also to protect it from being punctured. When rubber linings are subjected to hot, weak acid conditions, the surface of the rubber has a tendency to form "water bubbles." Although most acidproof brick linings are somewhat porous, they prevent the formation of such bubbles.

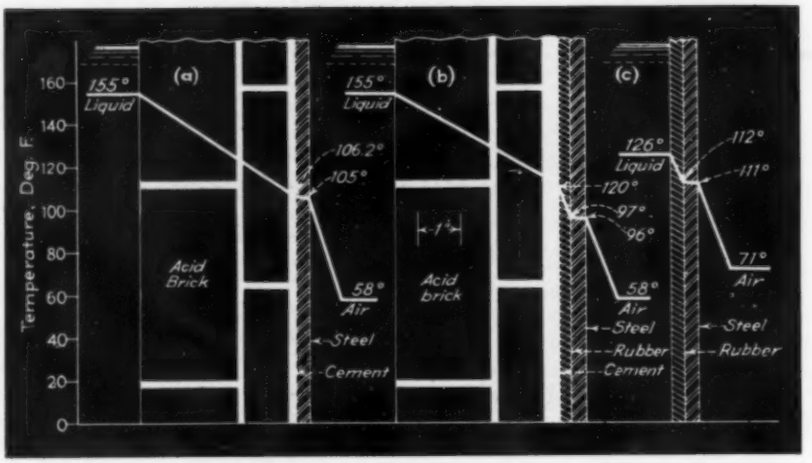


Fig. 1—Three-wall cross sections, drawn to scale, showing calculated temperature gradients through the various courses of material

TEMPERATURE DATA

We recently obtained some interesting readings of temperature drops through acidproof brick linings in one of our plants where there are two tanks, side by side, subject to the same temperature and corrosion conditions, containing hot HCl-salt solutions. Both are constructed of $\frac{3}{8}$-in. steel, one lined with $3\frac{5}{8}$ in. of acid brick (including thickness of the two joints) and the other lined with $3\frac{7}{8}$ in. of brick (including the two joints) plus a $\frac{1}{4}$-in. Triflex rubber lining. The cement is a self-hardening sodium silicate cement. The tanks are sketched in cross section in Fig. 1 (a) and (b). The temperature measurements included the air, 58 deg. F.; the steel surface, 105 deg. in case (a) and 96 deg. in case (b); and the liquid temperature, 155 deg. The amount of heat loss from the tanks was determined from charts supplied by the Harbison-Walker Refractories Co., from knowledge of the steel surface and air temperatures, coupled with the fact that the air was substantially quiescent.

Thus, for the first tank, the heat loss was taken as 82, and for the second tank, as 70 B.t.u. per sq. ft. and hour. We took K for steel as 26 B.t.u. per sq. ft., hour, deg. F. and inch of thickness, and used the formula $(T_1 - T_2)/Q = L_1/K_1 + L_2/K_2 + \ldots$, where $T_1 - T_2$ is the temperature drop across the section in question, Q is the B.t.u. heat loss per sq. ft. and hour as obtained from the charts mentioned, L_1 and L_2 are the inches thicknesses of each course of material, and K_1 and K_2 are the conductivities of the various courses, in B.t.u. per sq. ft., hour, deg. F. and inch of thickness. The conductivity K_1 for the brick lining and cement for the first tank was calculated as 6.2 B.t.u. per sq. ft., hour, deg. F. and inch of thickness. Using this figure for the second tank, Fig. 1(b), the conductivity of the rubber lining was calculated as 1.2 B.t.u. per sq. ft., hour, deg. F. and inch of thickness. For both tanks the temperatures at the boundaries of the various materials were calculated as shown on Fig. 1.

Later confirmation of the coefficient for the rubber lining was obtained from another tank of different construction in the same building. This tank was of $\frac{1}{8}$-in. steel, with a 0.2-in. Triflex rubber lining. As shown in Fig. 1 (c), the liquid temperature was 126 deg. F., the air temperature 71 deg. and the steel surface temperature 111 deg. The chart previously mentioned gave Q as 72 B.t.u. per sq. ft. and hour for these air and steel temperatures. Hence K for the rubber lining was calculated as 1.03 B.t.u. per sq. ft., hour, deg. F. and inch of thickness, and the steel-rubber boundary temperature as 112 deg.

RESIN CEMENTS

Synthetic resins have been known for many years, but as a rule they have been used mainly for the fabrication of molded or pressed shapes. Only recently have they been adapted for use in paints and cements.

Resin cements have advantages over sodium silicate cements in that they are practically impervious and do not shrink on setting. Also they have much greater mechanical strength and elasticity, so that the surface of a resin cement is quite

tough and resistant to wear. They are able to withstand thermal as well as mechanical shocks, and their setting time is readily controlled by temperature. For instance, at 70 deg. F., setting may commence only after 5 or 6 hours, whereas at 100 deg. F. the setting time is shortened to about 30 minutes. At 120 deg. F., at which temperature such cements may readily be worked, they set in about 5 minutes.

Resin cements are not attacked by acid conditions which are not strongly oxidizing, and they are often unaffected by weak alkalis. The temperature of use is limited to slightly above 350 deg. F., especially when there is plenty of oxygen present. Resins are inherently expensive and for this reason are used in acidproof construction work principally to protect surface joints in brickwork where their imperviousness and toughness are most desirable. As a pointing material, resin cements are used in surface joints of bricks which have been laid in such materials as sodium silicate cements, litharge cements, blast furnace cements, or portland cements. They usually will not set properly in the presence of water or alcohol, but adhere quite well to ceramicware and asphalt surfaces, and especially well to rubber surfaces.

COMBINATION JOINTS

When used as a pointing material in joints which have been bonded with alkaline cements such as sodium silicate or portland cement, resin cements adhere quite well after these surfaces have been neutralized by acid. A dilute (10 percent) hydrochloric acid is suitable. After the neutralization it is advisable to dry the joints before applying the resin cement. When portland cement is neutralized by 10 percent hydrochloric acid, bubbling occurs and neutralization should be continued until no more bubbling takes place on the addition of fresh acid.

In many cases, combinations of cements offer the best solution to corrosion problems. Acidproof bricks are often laid with sodium silicate cement, the surface joints being left open ¼ in. wide and ½ in. deep, rectangular in section. After this cement has set sufficiently (one or two days) the recesses are neutralized, washed and dried before the resin cement is squeezed into the recess. Instead of silicate cement, a combination of portland cement and resin cement may be used, but this requires an even longer time than the method just described because it is often advisable to allow portland cement to set for a considerable time before it is neutralized preparatory to pointing.

When construction time is of importance, a combination of a resin cement and a molten cement may be used. This usually adapts itself most readily to a two-course lining so that the surface course of bricks may be bonded with resin cement, and the molten cement poured in to fill the joints of the back course, and the joint between the two courses. Thus the resin cement serves several purposes—it acts as a seal to prevent the molten cement from running away while it is still liquid; it makes up the surface course which is exposed to the most severe corrosive and erosive conditions; and the complete surface course acts as an insulating medium to prevent the molten cement from becoming too hot during operation.

SETTING TIME

As already noted the setting time of a resin cement depends upon the temperature. Therefore, in this type of construction, if the bricks are warmed before being placed (as is recommended practice in the use of molten cements) the resin cement sets sufficiently so that the bricks will remain in place while the molten cement is poured behind them. The heat of the molten cement accelerates this set further so that the final lining can be put into service very soon after the bricklaying has been completed.

The setting of sodium silicate cements also is accelerated by temperature so that these cements, too, may be used in the surface instead of a resin cement. High melting asphalts may often be used as the molten cement in this type of construction.

At the present time the raw materials required to manufacture the sulphur and silicate types of cements are available without priorities, but many of the raw materials required to make resin cements are now under government control. Thus priorities are usually required with resin cement orders.

REFRACTORY MATERIALS

Continued from *Chem. & Met.'s* Materials of Construction Report, September, 1942

Representative Makers of Refractories and High Temperature Mortars

Manufacturer	Principal Types
Acme Brick Co., Ft. Worth, Tex	Firebrick and clay, h.t. cements, plastic refrs.
Alberene Stone Corp. of Va., New York, N. Y.	Refractory linings
American Crucible Co., Shelton, Conn	Graphite crucibles, silica and mullite refrs.
Armstrong Cork Co., Lancaster, Pa	Refr. insul. brick, h.t. mortars, 1,800 deg. insul. block and cement
Atlas Lumnite Cement Co., New York, N. Y.	Cement for refr., heat-resisting and insul. concrete
Babcock & Wilcox Co., New York, N. Y	Glass plant refrs., h.t. mortars, plastic refrs., insulating firebrick and kaolin refrs.
Bartley Crucible & Refr. Co., Trenton, N. J.	Graphite crucibles, magnesia and special refrs.
Betson Plastic Fire Brick Co., Buffalo, N. Y.	H.t. mortars, plastic refrs.
Botfield Refractories Co., Philadelphia, Pa	Chrome, firebrick, plastic refrs., h.t. mortars
Philip Carey Co., Lockland, Ohio	H.t. mortars, insulations
Carborundum Co., Perth Amboy, N. J	Silicon carbide, aluminum oxide, mullite and fused cast refrs. and h.t. mortars
Champion Spark Plug Co., Detroit, Mich	Sillimanite plastic refrs., electric furnace refrs.
Charlotte Chemical Labs., Charlotte, N. C	Refractory plastic
Corhart Refractories Co., Louisville, Ky	H.t. mortars, electro-cast refrs.
Corundite Refractories, Inc., Massillon, Ohio	Firebrick, h.t. mortars, plastic refrs., alumina, mullite refrs. and insul. refrs.
Denver Fire Clay Co., Denver, Colo	Firebrick, h.t. mortar, refr. castables, fireclays, plastic, high alumina and sillimanite refrs.
Joseph Dixon Crucible Co., Jersey City, N. J.	Graphite crucibles, stoppers, retorts, sleeve and nozzle brick, clay crucibles
Ehret Magnesia Mfg. Co., Valley Forge, Pa	H.t. mortar, insulation
Electro Refrs. & Alloys Corp., Buffalo, N. Y.	Mullite, fused alumina, silicon carbide and magnesia refrs., carbon bonded silicon carbide crucibles
Emsco Refractories Co., Vernon, Calif	Firebrick, glass plant refrs., h.t. mortars
The Exolon Co., Blasdell, N. Y	Silicon carbide, alumina refrs.
General Abrasive Co., Niagara Falls, N. Y	Alumina and silicon carbide
General Ceramics Co., New York, N. Y	Special refrs.
General Refractories Co., Philadelphia, Pa	Fired and unfired chrome and magnesite, firebrick, h.t. mortars, plastic and silica refractories
Gladding, McBean & Co., Los Angeles, Calif.	Firebrick, h.t. insul. brick and plastics, h.t. mortars, plastic refrs., fireclays, h.t. acidproof brick and cement

(*Continued next page*)

Makers of Refractories and Mortars *(Continued)*

Manufacturer	Principal Types	Manufacturer	Principal Types
A. P. Green Fire Brick Co., Mexico, Mo.	Firebrick, insul. f.b., h.t. mortars, plastic and castable refrs., fireclays	North American Refrs. Co., Cleveland, Ohio	Regular and super fire clay, high alumina silica brick, insulating firebrick, h.t. mortars, plastic refrs. and fire clays
Harbison-Walker Refrs. Co., Pittsburgh, Pa.	Refrs. of most types incl. reg. and super fire-clay, high-alumina, silica, chrome, magnesite, forsterite brick; clays; insul. firebrick and mortars; h.t. mortars	Norton Co., Worcester, Mass.	H.t. mortars, silicon carbide, fused alumina and magnesia, raw materials, cements, refr. shapes
Haws Refractories Co., Johnstown, Pa.	Firebrick of all kinds, silica brick, fireclays	Pacific Clay Products Co., Los Angeles, Calif.	Plastic refrs.
Illinois Clay Products Co., Joliet, Ill.	Firebrick, h.t. mortars, insulating cements, coatings and brick	Pyro Clay Products Co., Oak Hill, Ohio	Firebrick refrs., h.t. mortars, plastics, special shapes
Ironton Fire Brick Co., Ironton, Ohio	Fireclay refrs., refr. cements, fireclays	Quigley Co., Inc., New York, N. Y.	Firebrick, insulating refrs., super firebrick, h.t. mortars, plastic refrs.
Johns-Manville, New York, N. Y.	Bonding mortars, castables, ramming mixtures, plastic and insul. refrs.	Ramtite Co., Chicago, Ill.	Plastic and castable refrs., h.t. mortars
Laclede-Christy Clay Prod. Co., St. Louis, Mo.	Firebrick, h.t. mortars, plastic refrs., glass plant refrs., fireclays	Refractory & Insulation Corp., New York, N. Y.	H.t. mortars
E. J. Lavino & Co., Philadelphia, Pa.	Burned and chemically bonded chrome, magnesite and chrome-magnesia refrs., chrome base h.t. mortars	Robinson Clay Product Co. of N. Y., New York, N. Y.	H.t. mortars, firebrick and clay, insulating refrs.
Massillon Refractories Co., Massillon, Ohio	Refr. insul. brick and special shapes, muffles, smelters, crucibles, and lab. refrs., diaphragms and electrolytic refrs., firebrick, special shapes, glass plant refrs., h.t. cements and mortars, plastic refrs., high alumina, sillimanite, aluminum oxide, silicon carbide, sircon and special refrs.	Ross Tacony Crucible Co., Philadelphia, Pa.	Graphite crucibles and stopper heads, magnesite refrs.
		St. Louis Fire Brick & Insulation Co., Huntington Park, Calif.	Various
		Seaboard Refrs. Co., Perth Amboy, N. J.	Firebrick, h.t. mortars, plastic and insulating refrs., silicon carbide and mullite refrs.
		Chas. Taylor Sons Co., Cincinnati, Ohio	Firebrick, glass plant and insulating refrs., sillimanite
McLain Fire Brick Co., Pittsburgh, Pa.	Various	The United States Stoneware Co., Akron, Ohio	Plastic and castable refrs., fire clays, special refrs.
McLeod & Henry Co., Troy, N. Y.	Firebrick, h.t. mortars, plastic refrs., fireclays		
Mullite Refractories Co., Shelton, Conn.	H.t. mortars, plastic refrs., mullite refrs.	M. D. Valentine & Bro. Co., Woodbridge, N. J.	Firebrick
National Carbon Co., Inc., Cleveland, Ohio.	Carbon refrs.	Vitrefrax Corp., Los Angeles, Calif.	Firebrick, insul. firebrick, h.t. mortars, ref. castables, plastic refrs., fire clays
Niles Fire Brick Co., Niles, Ohio	Firebrick, insulating refrs.		

Physical Properties of Refractory Materials

(Compiled by L. J. Trostel, General Refractories Co., Baltimore)

Type of Brick	Silica	High Heat Duty (No. 1) Fireclay	High Heat Duty (No. 1) Kaolin	Super Duty Fireclay	Alumina-Diaspore, 70 PerCent Al_2O_3	Silli-manite (Mullite)	Chrome	Unburned Chrome	Magne-site	Unburned Magne-site	Bonded Silicon Carbide (Grade A)	Bonded Fused Alumina	Insul. Firebrick (2,600°F.)
Typical composition, per cent													
SiO_2	96	50–57[1]	53	52[1]	22–26	35	6	5	3	5	7–9	8–10	50–57
Fe_2O_3	1	1.5–2.5	2	1	1–1.5	0.5	.....	.....	6	8.5	0.3–1	1–1.5	1.5–2.5
FeO	.....	.....	.....	.....	.....	.....	15	12	.....	.....	.....	.....	.....
Al_2O_3	1	36–42	42	43	68–72	62	23	18	2	7.5	2–4	85–90	36–42
TiO_2	.....	1.5–2.5	2	2	3.5	1.5	.....	.....	.....	.....	1	1.5–2.2	1.5–2.5
CaO	2	.....	.....	.....	.....	.....	.....	.....	3	2	.....	.....	.....
MgO	.....	.....	.....	.....	.....	.....	17	32	86	64	.....	.....	.....
Cr_2O_3	.....	.....	.....	.....	.....	.....	38	30	.....	10	.....	.....	.....
SiC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	85–90	.....	.....
Flux[2]	.....	1–3.5	1	2	1–1.5	0.5	.....	.....	.....	.....	1.5	0.8–1.3	1–3.5
P.C.E. (with approx. equivalent temp., °F.)[3]	31–32 (3,056–3,092°)	31–33 (3,056–3,173°)	33–34 (3,173–3,200°)	33–34 (3,173–3,200°)	36–37 (3,290°)	37–38 (3,308–3,335°)	41+ (3,578°+)	41+ (3,578°+)	41+ (3,578°+)	41+ (3,578°+)	39 (3,389°)	39+ (3,389°+)	29–30 (2,984–3,002°)
Deformation under load,[4] per cent (at lb. per sq. in. and temp., °F., shown)	Shears 25 p.s.i. 2,900°	2.5–10* 25 p.s.i. 2,460°	6–7 25 p.s.i. 2,640°	2–4† 25 p.s.i. 2,640°	1–4† 25 p.s.i. 2,640°	0.0–0.5† 25 p.s.i. 2,640°	Shears 28 p.s.i. 2,740°	Shears 28 p.s.i. 2,955°	Shears 28 p.s.i. 2,765°	Shears 28 p.s.i. 2,940°	0–1 50 p.s.i. 2,730°	1 50 p.s.i. 2,730°	0.3 10 p.s.i. 2,200°
Resistance to spalling, per cent[5]	Poor	5–20	5–15	0–4	No loss	No loss	Poor	Fair	Poor	Fair	Good	Good	Good
Permanent linear change on reheating[6] (after 5 hr. at temp., °F., shown)	(+) 0.5–.8 2,640°	(±) 0–1.5 2,550°	(−) 0–1.5 2,550°	(±) 0–1.5 2,910°	(−) 2–4 2,910°	(−) 0–0.8 2,910°	(−) 0.5–1 3,000°	(−) 0.5–1.0 3,000°	(−) 1–2 3,000°	(−) 0.5–1.5 3,000°	(+) 2[8] 2,910°	(+) 0.5 2,910°	(−) 1.5[9] 2,550°
Porosity (as open pores), per cent	20–30	15–25	24–28	12–15	27–36	20–25	20–26	10–12	20–26	10–12	13–28	20–26	75
Weight per brick (std. 9 in. straight), lb.	6–6.5	7.5	7–7.5	8.5	7.5–8.5	8.5	11	11.3	10	10.7	8–9.3	9–10.6	2.25–3
Specific heat (60–1,200°F.)	0.23	0.23	0.22	0.23	0.23	0.23	0.20	0.21	0.27	0.26	0.20	0.20	0.23
Relative slag resistance[7]													
Acid steel slag	Good	Fair	Fair	Fair	Good	Good	Poor	Poor	Poor	Poor	Good	Good	Poor
Basic steel slag	Poor	Poor	Poor	Poor	Fair	Fair	Good	Good	Good	Good	Good	Good	Poor
Mill scale	Fair	Poor	Fair	Good	Fair	Fair	Good	Good	Good	Good	Fair	Fair	Poor
Coal ash slag	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Good	Good	Poor

[1] Higher in some districts. [2] Includes CaO + MgO + alkalis. [3] Pyrometric Cone Equivalent; terms "fusion," "softening," "deformation," and "melting" points heretofore loosely used. [4] Data marked (*) are from A.S.T.M. test C 16-36 with High Heat Duty time-temperature schedule; those marked (†) are from same test with Super Duty time-temperature schedule; others determined by other commonly used tests. [5] (+) means expansion; (−) means shrinkage. [6] Oxidizing atmosphere. [7] Ratings affected somewhat by varying temperatures and type of atmosphere prevailing. Resistance to coal ash slag affected by furnace temperature as well as analysis and fusion point of slag. [8] After 24 hr. [9] Loss in appropriate A.S.T.M. Panel Test.

Maintenance Tips for Engineers

AVOIDING ELECTRICAL CONTROL BREAKDOWNS HELPS MAINTAIN ESSENTIAL PRODUCTION

E. H. ALEXANDER *Industrial Control Division, General Electric Co., Schenectady, N. Y.*

CHEM & MET PLANT NOTEBOOK

ANY EQUIPMENT in daily use, upon which industry depends for continuity of service, requires periodic inspection and maintenance. Electric control is no exception to this rule. It is vitally important that controls be inspected regularly and that replacements or repairs be made quickly when necessary.

The selection of electric control for a given application depends mainly upon the factors of available power, surrounding conditions, and starting conditions. Before selecting control equipment, the manufacturer should be consulted if there are any unusual service conditions to be met, such as a damp, dusty, corrosive or explosive atmosphere, or if the equipment is to be subjected to vibration, shocks or tilting.

After the proper control has been selected it must be installed correctly and the necessary adjustments made before putting it into service. Panels must be mounted vertically, so that the contactors will open by gravity when power is cut off, and a proper ground connection must be provided. Before power is applied, each contactor and relay should be operated by hand to see that the moving parts operate freely and without binding. All electric interlocks should be clean and should make good contact when closed.

Resistor boxes should always be mounted with the grids in a vertical plane, and should be so located that free ventilation is permitted. To keep heating at a minimum, it is recommended that 6-in. spacers be used between boxes when stacked, and that the stacks be 12 in. apart.

Adjustments—Contactors are designed to operate properly if the line voltage is within 85 to 110 percent of the panel nameplate rating for a-c circuits, and within 80 to 110 percent for d-c circuits. Wider ranges require special devices.

Where there is a continuous 10 percent increase in voltage, suitable coils should be ordered, because, with this increase in voltage there is an approximate 50 percent increase in wattage, which greatly increases the heating of the coil, and reduces its ultimate life.

The armatures should seal (close) when the proper voltage is applied to the coils and should open by gravity when the power is cut off. All contact tips should, when closed, make line contact near the bottom of the face. On opening, the final break will be near the top. The rolling and wiping motions when closing and opening keep the contacts in good condition.

PREVENTIVE MAINTENANCE

A first consideration in keeping control equipment in proper working condition is to prevent an accumulation of dirt, oil, grease or water on the operating parts of the control. It is, therefore, advisable to carry in stock protective paints for the stationary iron parts, and insulating varnish of the proper characteristics for the coils.

Where the air is saturated with moisture, or subject to the action of corrosive gases, it is well to inspect and paint the various control parts from two to four times a year, depending on the severity of the operation conditions.

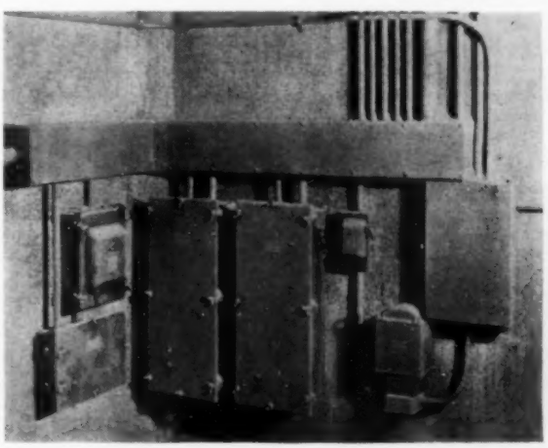
It is often desirable to add heaters or lamps within the controller inclosure to prevent condensation of excessive moisture, which for best results should be energized continuously.

Circuit breakers or contactors are usually of very rugged construction. Still, it is best to operate them by hand from time to time and check to make sure that all of the clearances are normal and that parts are working freely. Should parts become worn so that adjustments cannot be maintained, new parts should be used. Adjustment and cleaning, as well as renewal of the tips, is necessary and depends on the frequency with which each device is operated.

Occasional inspection should be made of all nuts and connection wires on panels and resistors, particularly when subject to vibration. Close inspection of pigtail connections should be made periodically since these are of finely woven wire for flexibility, and

Right—Panels should be mounted vertically so that contactors will open by gravity when power is off

Below—Surrounding atmosphere largely determines the inclosure, as in these starters for dusty service



hence are subject to rapid corrosion under adverse conditions.

Float switches should be given the best of care, especially if they are of the moving contact type. The tips should be adjusted and lined up properly and, of course, cleaned if any indication of excessive corrosion is noted. The bearings should be made free to operate and any tendency towards binding should be corrected immediately.

TROUBLE SHOOTING

Troubles are bound to occur in the best of control equipment. Knowing what to do about them when they do occur will save much precious production time.

Contactors—A contactor has several bolted or spring-closed contacts. Excessively high resistance at these contacts is the cause of the very high temperatures, such as 100 to 200 deg. C., that may be reached when the contactor is carrying rated current or less. The most likely point of high resistance is at the contact itself, where the movable tip makes contact with the stationary tips.

However, high resistance may occur at any of the several bolted joints on the contactor. Therefore, if one of these devices begins to develop an excessive temperature, a millivoltmeter should be used to determine which of the several joints has a high-voltage drop across it.

When the copper contact or contacts that have excessive drop across them have been located, correction can be made by opening the contact and removing the oxide with a file (not with sandpaper or Carborundum paper). It is unusual to find a high resistance in a bolted joint unless the contactor has been much over-heated.

The foregoing comments apply particularly to copper contacts because they oxidize readily, and the copper oxide formed has a very high resistance. Depending on various conditions, it may take a short or long time for the formation of sufficient oxide to cause excessive heating under ordinary types of service. However, if sulphur-containing gases are present, a high-resistance film will develop quite rapidly. To prevent this action, the contactor should be mounted in a tightly gasketed inclosing case, or immersed in oil.

When it is desired or necessary to maintain a low resistance of the active contact without servicing, a silver face can be brazed to the two tips. Silver will oxidize and the oxide has a higher resistance than the pure metal, but when heated, silver oxide has the unusual property of reverting back to the metallic form.

Electrical interlocks may fail to make circuit because of oxidation where copper contacts are used. Sometimes such failure occurs because dirt gets between the contacts. By using one hemispherical and one flat tip made of silver, both of these troubles will be overcome.

Renewal parts should be kept handy so that replacements can be made quickly

Some maintenance men have the erroneous impression that contact tips that have been roughened by service should be kept smoothed so that they will carry the load. A roughened tip will carry current just as well as a smooth tip.

Of course if a large projection should appear on a tip because of unusual arcing it should be removed, but a tip that has been roughened by ordinary arcing need not be serviced.

Coils—A large percentage of contactor coil troubles can be traced back to heating. Therefore, if the temperature can be reduced coil troubles can be greatly decreased. Since the heating of a d-c coil will vary as the square of the voltage, and the heating of an a-c coil will vary about as the cube of the voltage, it follows that coils should be wound for the voltage that exists on the line. If the ambient temperature is high, this precaution is all the more important.

When an a-c magnet, such as a solenoid, is supplied with constant-voltage excitation it requires a large inrush of current to close the armature. When the armature closes the coil current drops to a normal value. Sometimes, however, armatures may not close because of excess friction or for some other reason and the large inrush current may burn out the coil within a few seconds. Such mishaps can be prevented by the use of a thermal cutout to protect the coils.

Resistors—Resistors are of many types, some of which are more prone to troubles than others. Excessive heating may occur in those having bolted or clamp type joints and the remedy here will be either to insure a clean, tight joint, or in some types, to braze the joint. When cast grid resistors sometimes give trouble by breaking, especially due to machine vibration, the best correction is to replace the grids with an edge-wound or strip resistor which is unbreakable, and is also made of corrosion resisting material capable of withstanding high temperatures without scaling.

Timing Relays—There are many varieties of relay. A number have been designed to operate as a function of time. The one first designed for this purpose was the dashpot type which, however, has certain inherent troubles that have led to the development of other types of timing relays. A dashpot is essentially a close-fitting device that is easily affected by dirt, gumming of the oil, and corrosion of the close-fitting parts. Also the torque of the magnets varies with the position of the solenoid armature in its coil.

If trouble is experienced due to tripping while starting a motor or shortly after getting up to speed, there are three things that can be done: (1) A heavier oil may be used if the relay almost holds. (2) A starting contactor can be used that excludes the overload relay from the circuit until the running contactor comes into operation. Or, (3) The dashpot can be replaced with a temperature type of overload relay.

Temperature Overload Relay—Since the function of a temperature overload relay is to protect a motor under all ambient temperatures, its final temperature should be the same as that of the motor—which is 90 deg. C. Therefore, the relay should just trip if placed in a 90 deg. C. ambient. If a relay does not function correctly, it should be immersed in a pail of water kept at 90 deg. C. and adjusted so that it will. A temperature overload relay does not need any such maintenance attention as outlined for dashpots, but its use does require certain precautions, for example, shielding from strong drafts or sources of heat.

Time Delay Relay—The third type of relay is used for controlling the rate of acceleration of motors and for many other functions where a short time-delay is needed. In the escapement type of relay, a pendulum is used as the governing means, which makes it necessary to mount the relay in a definite position with respect to the motion of the pendulum. To overcome this limitation a new design that has a balanced pendulum has been made available. If the old-type escapements fail to time properly, their mounting position should be checked, or the use of the balanced type should be given consideration.

Corrosive fumes in many plants, such as those manufacturing rayon, coke, sulphuric acid, nitric acid and chlorine, rapidly attack the metal parts of control devices and render them inoperative. Hence, the operating parts are frequently immersed in oil in a container capable of withstanding the corrosive atmosphere. When it is impracticable to oil-immerse a given type of control, the equipment is inclosed in a heavy case with a tight, gasketed cover.

CHEM & MET REPORT ON

Recent Advances of Catalysis in Chemical Process Industries

TO EXECUTIVES AND ENGINEERS IN PROCESS INDUSTRIES

Seldom, if ever before in the history of the chemical process industries of this country, have so many important developments been industrialized within so short a period as during the past four years. These developments, largely in the fields of organic chemistry, petroleum technology and synthetic rubber, are characterized by the facts that they are mostly catalytic in nature and that many of them, though conceived in peace, have received their initial industrialization from the war emergency. For it is true now as in World War I that the demands of a war economy initiate and catalyze new chemical developments at an unprecedented rate. This report, lacking the space even to mention many of the industrial advances in chemical catalysis in recent years, deals primarily with catalytic processes involved in this country's programs for producing 100-octane aviation fuel, toluol for T.N.T., and raw materials for synethetic rubbers — all revolving principally around the butane-butylene fractions of petroleum refinery and natural gases. America's most potent secret weapon in this war is catalytic chemistry with butane hydrocarbons as ammunition.

CHEMICAL AND METALLURGICAL ENGINEERING · OCTOBER, 1942

Recent Advances of Catalysis in Chemical Process Industries

SUMMARY AND CONCLUSIONS

Catalysis, that potent force in industrial chemical processes which has suddenly become so all-important in our war effort, is still a comparatively new and little-understood factor for many chemical engineers. In this report, both theory and practice have been briefly surveyed for the benefit of those engineers who would like to know more about catalysis and its role in our war technology.

Dr. Norman W. Krase, an outstanding authority in the entire field, deals with some of the fundamentals of research is catalysis, including the peculiar problems encountered, factors that make for success or failure, and the importance of special requirements for progress in the field. As the complexity of new applications multiply and the volume of research grows at an increasing rate, it is only by giving greater heed to special techniques that catalysis can emerge from an art into an engineering science.

Industrial developments in catalytic chemistry have, in recent years, been focused on petroleum technology and interconversion of petroleum hydrocarbons. High-octane aviation fuels, toluol for more T.N.T., and synthetic rubber processes all depend to a large extent upon petroleum raw materials converted by catalytic processes. Hence, the second part of this report is limited to a brief survey of recent industrial developments in the processes for producing these essentials of war. Voluntary censorship has, of course, limited disclosure of certain operating details and other data.

Basic Considerations

NORMAN W. KRASE *E. I. du Pont de Nemours & Co., Wilmington, Del.*

IN THE FIELD of catalysis there are two factors of major importance. The first is the equilibrium composition that a system attains under selected reaction conditions, the second is the rate at which the composition of the system moves or *can be moved* toward that equilibrium. The problems are, therefore, concerned first with selection of reaction conditions under which favorable equilibrium can be established and second, with means for speeding up the changes in composition that must occur to reach or approach equilibrium.

Thermodynamics is of immense aid in selecting favorable reaction conditions. There is no exact science to aid in selecting the means for accelerating chemical reactions. To say that catalysis is an art is trite but also true. It is to be hoped that out of the vast accumulation of catalytic information—past and future—will come a generally applicable explanation of the action of catalysts. That goal appears to be far away. To reach it there must be general appreciation of the peculiar problems met in this field. To illustrate some of these problems, both in academic and industrial catalysis, let us consider a common case in heterogeneous catalysis.

PROBLEMS ENCOUNTERED

A mixture of gaseous reactants is to be processed over a solid catalyst to produce a desired compound. Thermodynamic calculations based on available thermal data determine the temperature range in which a satisfactory equilibrium composition can be attained. From the equilibrium constant an operable pressure range is chosen. Other operating factors, such as the molecular ratio of reactants, may frequently be determined by considering methods of recovering the product from the crude reaction mixture and the effect of more complete conversion of one reactant on the ease of recovery. The reactant ratio obviously bears also on the problem of suppressing undesirable side reactions that may occur under the operating conditions selected. In some cases, practically complete conversion of one reactant obtained by using a large excess of others will eliminate or greatly simplify the recovery problem. These considerations are, of course, not limited to catalytic reactions only and follow directly from the application of fundamental physical chemical principles. The next problem is the selection of the catalyst and at this point chemical principles cease to be of aid. Experiment is the sole recourse. The point where experiment begins depends on the knowledge and background of the investigator.

In an industrial organization with long experience in the study of catalysis, the background may be considerable and selection of candidate catalysts for experimental testing can be made with reasonable assurance that the substance will be active. Without such a background, the investigator has available only the published results of other workers on the same or analogous systems and the guidance of any theories of catalytic behavior to which he may subscribe. In the words of Wilder Bancroft, "A

good theory is one that leads to an experiment."

SUCCESS-OR-FAILURE FACTORS

These preliminary considerations now bring us to the main problem of catalysis—industrial or academic—and an elaboration of the prime factors that determine success or failure of the investigation. In "success or failure" are included—for the academic worker—the feasibility of others to reproduce his results, while for the industrial worker the term includes the ability to interpret experimental data so that the reaction may be scaled up to commercial operation. It is on this very important point that the main difference between industrial catalysis and any other kind appears. The academic worker ordinarily has no opportunity to test his conclusions on a larger scale or even to extend his work beyond the narrow limitations of laboratory apparatus. He should, however, give full consideration to the possibility of reproduction of his work by others. This is not to disparage the contribution that academic workers can or have made to this field but rather to focus attention on the main desiderata that have made some published work worthless.

Because catalysis is a designation used in lieu of scientific explanation, it is best to approach the problems with complete awareness that *any* factor may be important. Continuing our consideration of a common case of heterogeneous catalysis, we begin experimental work. The catalyst is prepared and the reactant gases processed under selected conditions. Evaluation of the experimental results leads to further experiments to improve them. Such further experiments are designed to determine the effect of selected variables such as catalyst composition, temperature, pressure, time of contact, reactant ratio and others. With each change in conditions, the investigator attempts to develop a better understanding of the catalytic process so that gradually, with accumulated facts serving as guideposts, he reaches a satisfactory solution.

Frequently, at this point, the results are published and become a part of the raw material out of which attempts will later be made to fashion a comprehensive and scientific theory of catalytic action. If the work has been well done, progress has been made toward that desirable goal. If, on the other hand, the materials used in preparing the catalyst were impure or of unknown composition in respect to traces of impurities, or if the reactant gases contained unrecognized constituents, or the exact procedure of catalyst preparation has not been disclosed, it may be difficult if not impossible to reproduce the results. Deductions based on such results must also be faulty.

In the case of industrial research, the attainment of satisfactory laboratory results marks the beginning of larger scale work which applies rigorous tests of the validity of the conclusions reached. In addition, new problems are faced. The shift from laboratory to plant scale may be accompanied by necessary changes in materials of construction, in the source and purity of gases, in the raw materials for catalyst manufacture, and in the accuracy of control of operating variables. These and other factors are capable of profoundly influencing the results. Let us examine a few of the causes of inability to scale up results.

CATALYST ACTIVITY

A solid catalyst frequently contains several elements. It may be predominantly one metal, such as copper or iron, to which have been added small amounts of other metals, oxides or salts. The composition of a catalyst can be determined with great accuracy by analytical methods. It is a well known fact, however, that catalysts of identical composition may have widely different activities. The explanation must lie in the methods of preparation. For most chemical purposes, a reaction between two compounds in solution may be carried out over a range of temperature and concentration conditions to get a desired product. It is not uncommon in the case of catalyst preparation to find that the temperature, concentrations, order of addition, degree of agitation and similar factors have a bearing on the activity of the final catalyst.

An active catalyst can be ruined by exposing it to certain temperatures or to certain atmospheres without a measurable change in its composition. To define the method of preparation to include *all* factors is a task requiring meticulous attention to detail. Too often results cannot be duplicated because of omission of preparative detail. To say that a catalyst is copper is to say that the minor impurities that frequently accompany copper are of no importance. In a high state of purity copper differs from ordinary copper "promoted" by impurities. Emphasis on purity is applicable equally to reactants.

Initial laboratory work should be done with substances of the highest attainable purity so that an understanding of the chemistry of known compounds is obtained and not that of a fortuitous mixture. The effect of impurities can only be gauged by comparison with the known behavior of pure reactants.

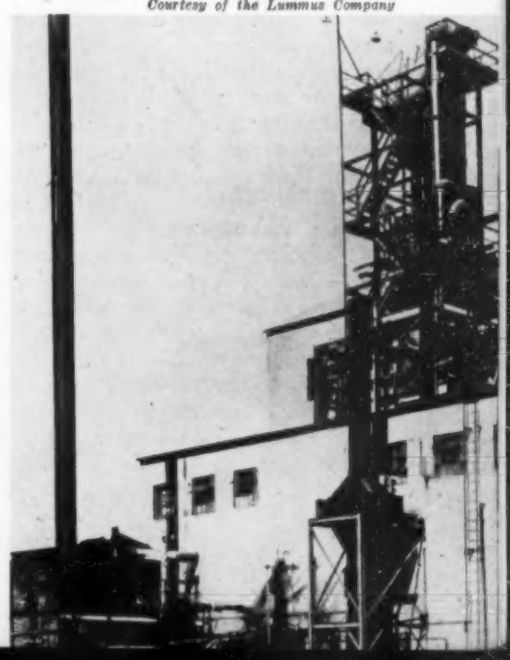
Translation of laboratory results to practical plant conditions raises questions of gas purity that can be answered in either of two ways: (1) rigorous purification of the gas to be processed; (2) development of tolerance in the catalyst to permit processing impure gas.

Experience with a large number of cases establishes the former as a generally superior procedure. For reasons that are not known, a catalyst working on pure gas almost always has a higher productive capacity and a longer life than when used on impure gas. This is not to say that catalysts insensitive to poisoning by impurities are not to be preferred because irregularities in operation of the purification system may subject the catalyst to impurities and cause deactivation. A combination of ruggedness, tolerance for foreign substances, and maximum capacity and activity is an ideal rarely reached in industrial catalysis.

On the other hand, rigorous purification of thousands of cubic feet per hour of gas is a chemical engineering problem of great magnitude and an operation that adds considerably to the cost of the product. As a compromise method of operation that under some circumstances has much

This 500 bbl.-per-day Thermofor Continuous Catalytic Cracking plant saves strategic construction metals and can produce materials for 100-octane gasoline, butadiene and toluol

Courtesy of the Lummus Company



to commend it, we find "guard" catalysts employed. Such a catalyst is rugged and tolerant of small concentrations of poisons difficult to remove from the gas but is also of sufficient activity to cause the desired reaction to occur to a limited extent. The product so formed is separated from the unconverted gas, carrying with it in some cases a considerable fraction of the poisons. The last traces of poisons combine with the guard catalyst, leaving a highly purified gas to be sent on to the converters where the main synthesis of the product occurs. In this way, long life and high activity of the catalyst is obtained and the guard catalyst can be renewed at intervals so as to maintain its protective function.

LABORATORY-PLANT TRANSFER

Transfer of a catalytic process from laboratory to plant may result in uncovering phenomena that are non-existent in the small scale work. Large volumes of catalyst are difficult to maintain at constant or uniform temperature. Uneven flow or channeling of reactants through large cross-sectional areas of catalyst may localize heat effects so that the temperature is raised or lowered to unfavorable levels. Local overheating can cause catalyst deterioration or disintegration. Furthermore, the movement of catalyst particles in a bed by high velocity gas may cause considerable abrasion and powdering.

Such problems are usually not met in laboratory work and when encountered on a larger scale may reopen the whole problem of catalyst development. To meet such situations, there have recently been developed modified methods of operation in which the catalyst is suspended in the stream of reactants for a sufficient period to accomplish the desired conversion and then separated. The recovered catalyst can be discarded or used again with or without treatment to restore any lost activity. These "fluid catalyst" processes have found application in processing petroleum hydrocarbons at high temperatures where carbonaceous deposits tend to form on the catalyst and cause deactivation. Their utility in such cases lies also in the fact that continuous processing is possible instead of a cycle involving intermittent purging and cleaning of a stationary catalyst bed.

The accomplishments credited to catalysis are numerous and important. Both academic and industrial workers have contributed to the progress. As the complexity of new applications increases, as the volume of research on catalysis grows at an increasing rate, we will be well advised to give greater heed to the special requirements for success in this field. Only in that way can this art become a science.

Recent Applications

EDITORIAL STAFF

IN THE FIELD of petroleum technology, few industrial processes have attracted such wide attention within such a short time as those involving catalytic cracking of the heavier hydrocarbons into the lighter, gasoline constituents. Although thermal cracking methods have been practiced for many years, it was only in 1938 that the first large-scale Houdry catalytic cracking plant began operations. However, by the latter part of 1941 there were already 16 Houdry plants operating or in construction, with cracking capacities ranging from 8,000-20,000 bbl. per day.[1] Today, there are even more, the exact number and capacities being a military secret. This process, highly important in our war economy, gives high yields of 80-octane gasoline from distillate fuel oil. It is capable of taking all the hydrocarbons in a wide-boiling range stock and converting them into an unusually uniform gasoline product regardless of the type of raw stock that is handled. The product is highly suitable for blending to 100-octane aviation fuel. Also important for the synthetic rubber program is the fact that this process produces an aviation fuel base stock without drawing upon our vital supplies of butane and butylenes, principal petroleum raw materials for butadiene.

CATALYTIC CRACKING

Among catalytic cracking processes, of course, are others such as those of the Universal Oil Products Co. and the newer naphtha reforming process controlled by M. W. Kellogg & Co., Standard Oil of New Jersey and Standard Oil of Indiana.

Importance of catalytic cracking has been shown by Wilson[2], who stated that within the next few years it is expected that units treating something in the order of 500,000 bbl. per day will be in operation. Such units will be capable of converting about 50 percent of the material charged to the catalyst into 80 motor octane or 90-95 research octane gasoline. These 250,000 bbl. per day of extremely high octane gasoline should be compared with requirements for premium grade motor gasoline for 1941, which was approximately 180,000 bbl. per day.

Within the past two years, definite improvements have been made in operating practice for the Houdry catalytic cracking process. These improvements are the result of new types of catalysts rather than radical changes in basic designs.[1] Major improvements are higher gasoline yields and octanes in the conversion of heavy overheads from reduced crudes, gas oils and the reforming of certain natural stock.

Catalyst used in the Houdry catalytic cracking process consists of a mixture of activated oxides of alumina and silica, the mixed oxides being decidedly superior in activity to either oxide alone. Pressures range from 40-60 lb. per sq.in. and the operating temperature is about 850 deg. F. Certain naturally occurring clays, such as the montmorillonites, have superior catalytic behavior in these reactions compared with other types of natural alumino-silicates.[3]

Catalysts in these cracking processes actually permit rupture of the carbon-carbon linkages in the long hydrocarbon chains, decrease the amount of polymerization to tar and at the same time encourage aromatization and isomerization of the cracked fractions in the desired boiling range. According to Taylor,[3] research utilizing heavy hydrogen as an isotopic tracer shows that active cracking catalysts cause carbon-hydrogen bond exchange at temperatures well below cracking temperatures. This indicates that the dehydrogenation of the hydrocarbon molecules is a condition precedent to the rupture of the carbon-carbon linkage.

As the cracking reaction proceeds, carbon or "coke" is deposited on the surface of the catalyst particles, thus decreasing their activity. It then becomes necessary to revivify the catalyst. Oil vapors are shut off, vacuum applied to purge the system, and then preheated air is admitted to burn off the deposited carbon as carbon monoxide, with the liberation of heat. The staggered use of batteries of catalyst

Table I—Typical 100-Octane Gasoline Blend

Blending agent (88-100 octane)	50%
Base stocks (75 octane)	40
Isopentane	10
Tetraethyl lead (Max. per gal.)	3cc.

chambers insures the continuous operating cycle. The actual regeneration cycle is short; about 10 minutes on stream, 5 minutes purge, 10 minutes for the regeneration and then a 5-minute purge. The catalyst lasts more than six months and frequently more than a year.

Temperature control in the catalyst "cases" is important. Heat must be supplied to maintain a cracking temperature of 850 deg. F., while temperatures during regeneration must not exceed 950 deg. F. Satisfactory heat transfer can be obtained by using a mixture of sodium nitrite, nitrate and potassium nitrate as transfer fluid in the cases.

FLUID CATALYST

The Houdry catalytic cracking process as described above employs a solid or "lump" catalyst either in a fixed or moving bed. However, in 1941 the Standard Oil Co. of New Jersey announced[4] a new catalytic cracking process which uses a so-called "fluid" or moving catalyst. This, in powdered form, is suspended and flows along in intimate admixture with the oil stream passing through the catalytic system. The catalyst is separated from the reaction products by centrifugal force in a separator of the "cyclone" type and passed through a regenerating system where the coke is burned off with air. The main advantage of this type of catalyst is that it renders the process continuous throughout. Operating pressure is low, probably not more than three or four atmospheres.

The first full-scale cracking plant embodying the "fluid" catalyst principle was completed this year and is now operating successfully.[5] It will be followed by 30 or more units now being built by Standard Oil of New Jersey and others in the industry under license.

Announcement has been made that with slight modifications in operating methods, fluid catalytic plants can be made to produce simultaneously large yields of high-octane gasoline and as much as three times the amount of butenes for butadiene as originally contemplated. This subject of raw material for synthetic rubber production will be discussed later in this report.

Very recently, the Lummus Company announced an important development in plant conversion to catalytic cracking for production of source materials for 100-octane gasoline, butadiene and toluol. According to this, any existent thermal cracking or topping unit can be converted to a "Thermofor" catalytic cracking plant by the addition of a reactor, Thermofor kiln, catalyst elevators and facilities with a saving of approximately 50 percent in strategic materials over a complete unit. Six Thermofor catalytic cracking conversion elements and a number of complete plants are already under construction by Lummus for major oil companies. The process is licensed by the Houdry Process Corp.

According to the latest information[6], there are at least 16 companies known to be engaged in the present program of producing 100-octane fuel by various methods, including catalytic cracking processes. By next year the number will be more than doubled. The proportion in which super-fuel is believed to be derived from the various processes used in its manufacture is given in Table II. However, with the completion of catalytic cracking plants now scheduled, it is expected that well over half of our 100-octane base stock will ultimately be supplied by this process as compared to the 20 percent that is now supplied.

HYDROFORMING PROCESS

Another important recent development[6] in petroleum technology, especially now that this nation is at war and hence needs larger amounts of toluol as well as high-octane fighting fuel, is that of "hydroforming". This is a high-temperature, high-pressure catalytic process that combines dehydrogenation with aromatization, using straight run or catalytically cracked naphthas as charging stock, to produce high-octane gasoline. The conversion takes place in a hydrogen-rich atmosphere.

Most important characteristic of the hydroforming process is the catalyst, which causes ring formation and ring closure in hydrocarbon molecules which have just undergone partial dehydrogenation. Hence the final product contains a high percentage of aromatics as compared to the feed. The first large-scale hyroformining plant, put in operation during 1941 by the Pan American Refining Corp., can take a charge of 40-45 octane number heavy naphtha and reform it with an 80 percent yield into 80 octane gasoline, or by changing operating conditions, can equally as well produce upward of 80 percent aromatics, chiefly toluol and xylol. This single unit alone could produce approximately 5,000,000 gal. of toluol yearly.[6] Operation of the process is similar to other "fixed-bed" catalytic processes. As in the Houdry process, coke is gradually deposited on the catalyst, so that eventually it becomes necessary to remove it by burning.[7] However, the lack of very reactive olefin hydrocarbons allows a relatively long cycle of operation before coke or carbon dulls the activity of the catalyst.

Table II—Present Relative Importance of Processes Producing Super-Fuel Stocks[5]

Base Stock	
From natural naphthas	70%
By catalytic cracking	20
By hydrogenation	10
Blending Stock	
By alkylation	95
By hydrogenation	5

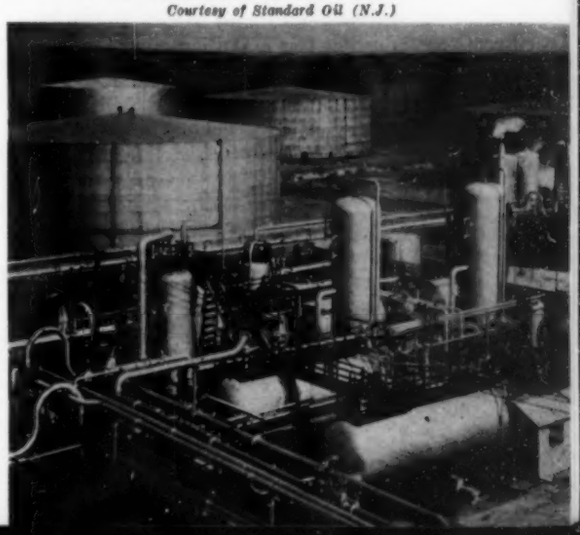
CATALYTIC TOLUOL

Catalytic dehydrogenation-aromatization of hydrocarbons containing six or more carbon atoms can be obtained in a temperature range of 840-1,020 deg. F. in presence of a group of catalysts including the oxides of chromium, molybdenum, and vanadium supported on activated alumina.[8] Silica is inactive as a supporting material. Straight-chain hydrocarbons are dehydrogenated and converted to cyclic hydrocarbons with eventual formation of aromatics. Cyclization is accompanied by some decomposition and deposition of carbon, so that the catalyst mass must be revivified by burning off this carbon with air. Yields of toluol from normal heptane as high as 90 percent have been reported. Other products from normal hexane and octane are benzol and xylol, with the latter being formed more easily than benzol.

Although toluol was first produced

Catalytic alkylation plants similar to this Texas unit furnish some 95 percent of the blending stock for America's aviation super-fuel

Courtesy of Standard Oil (N.J.)



in this country from petroleum in 1940, it has been estimated[9] that probably more than some 70 percent of our toluol needs will soon be derived from petroleum raw materials. Catalytic processes as described above will account for most of this capacity. In fact, the largest petroleum plant manufacturing toluol in this country began operations in 1941, employs the catalytic method and has a capacity of nearly 30,000,000 gal. annually. Many other catalytic plants are now under construction at various locations. Thus production of toluol from petroleum raw materials by cyclization and by hydroforming, previously mentioned, represents a major contribution of catalytic chemistry to the war effort. In addition, toluol is obtained from petroleum bases by various simple extractive methods.

Table III—Requirement for Output of Petroleum Industry, Bbl. per Annum[15]

High octane gasoline (100 and over)	91,250,000
Toluol for TNT	6,000,000
Butadiene for synthetic rubbers	3,400,000

Note:—The above butadiene figure is based on the assumption that 225,000 short tons of butadiene requirements will be obtained from alcohol and 423,200 tons from petroleum bases. This total of 648,200 tons of butadiene (Rubber Reserve Corp., as of July 15) was revised to 717,800 tons (American Chemical Society meeting Sept. 9). A recent communication from the Sun Oil Co. places the final production of butadiene from petroleum sources for synthetic rubber at 660,000 tons annually. Of the 476,000,000 gal. of alcohol est'mated to be needed for war purposes in 1943, it has been predicted that more than half will be used in the manufacture of butadiene.

ALKYLATION FIGHTING FUEL

Though hydrogenation was the original commercial process for making 100-octane blending agent, it has since been largely replaced by a newer method called alkylation, a modified type of polymerization. In fact, some 95 percent of blending stock for super-fuel is now being produced by alkylation processes. The first plant using the catalytic alkylation process in this country was put in operation in 1938 by Standard Oil of New Jersey. However, within the last few years, considerable advances have taken place in the technique of alkylation and it is now possible to produce an alkylate of at least 95-octane number suitable as the major blending component of 100-octane aviation gasoline.[10]

Catalytic alkylation processes usually employ concentrated sulphuric acid as catalyst to promote joining an isoparaffin (such as isobutane) with an olefin (such as butylenes and amylenes). If isobutane and butylene are taken as charging stocks the final product is iso-octane. The process is stated to be the best available for a high yield of 100-octane fuel from a given quantity of olefin. It can produce at less cost than any other process available to the industry at the present.

Catalyst used is 98 percent sulphuric acid and the charge usually consists of the butane-butylene mixture from a cracking or dehydrogenation plant plus additional isobutane from an absorption plant or from isomerization of normal butane. Spent sulphuric acid catalyst leaves the unit at a strength of 88-91 percent. The operation is carried out at atmospheric pressure and a temperature of about 95-123 F.[11] The reaction is rapid and exothermic and appears to take place in two steps. The first involves formation of an alkyl ester such as butyl hydrogen sulphate. This is followed by combination of this material with isobutane and liberation of acid. The higher the ratio of isoparaffin to olefin in the feed-stock, the greater is the yield, the higher the octane number, and the smaller the acid consumption. Hence, this ratio is usually held at 5:1 or higher. Commercial plants often operate with contact time of 20-40 min. Make-up acid may amount to 1-3 lb. per gal. of product, but frequently is less than 1 lb. per gal. of alkylate.

Another alkylation process in commercial operation is the non-catalytic "neohexane" method in which isobutane and ethylene are alkylated at about 950 deg. F. and 3000-5000 lb. pressure to neohexane, which has an octane rating of about 94.[12] This thermal process was announced in 1939.

Universal Oil Products Co. has just announced the development and licensing for commercial operation of a hydrogen fluoride catalytic alkylation process. Installations are under construction in a number of refineries. This process is of war-time importance since it uses more of the available olefins for alkylation than the sulphuric acid process. The hydrogen fluoride catalyst not only causes reaction of isobutane with butylene, but also reacts isobutane with propylene and pentylenes to give additional supplies of alkylate suitable for blending in 100-octane fighting aviation gasoline. Isobutane for the process is obtained by isomerization.

POLYMERIZATION PROCESSES

Industrially, polymerization is older than certain of the other catalytic petroleum treating processes, since it really became a factor in petroleum refining some seven or eight years ago. Catalytic polymerization is applied commercially to propylene and butylenes to form liquids in the gasoline boiling range. Products' process uses orthophosphoric acid, copper pyrophosphate, and sulphuric acid as catalysts. The Universal Oil Products' process uses orthophosphoric acid on a solid carrier, while the Polyco process (Polymerization Process Corp.) uses copper pyrophosphate. Operating temperatures of both processes range from about 250-400 deg. F. and pressures are about 700-1000 lb. Catalyst life averages about 90 gal. of polymer per pound of catalyst, with 85-95 percent conversion of byproduct propylene and butylene gases from the cracking, decomposition or dehydrogenation operations to polymer gasoline. This polymer has an octane number of about 84, but a blending value equal to 110-130 octane rating. Much of this product finds its way into aviation fuel.

For a number of years the Shell catalytic polymerization process has been converting butylene into octenes by the use of sulphuric acid. The original Shell cold-acid process converted isobutylene, while the more recent hot-acid method polymerizes a portion of the normal butylene along with the isobutylene. Details of the two processes have been given by McAllister.[13] The octenes produced by polymerization are then catalytically hydrogenated to octanes.[14]

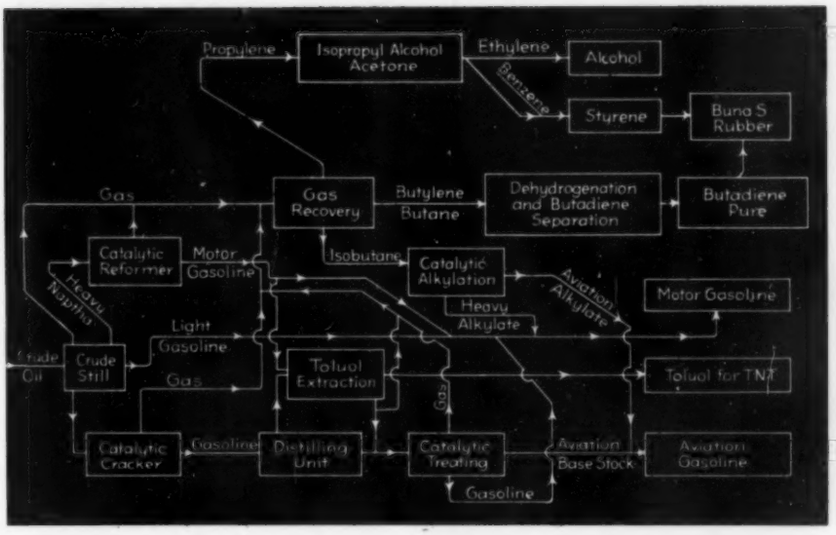
Also of industrial importance is the Universal Oil Products Co. process for converting, by catalytic polymerization, the isobutylene fraction of petroleum gases into iso-octenes which, by hydrogenation, are converted into iso-octanes. The iso-octanes produced by hydrogenation have octane ratings of 95-98, and some individual octanes have values in excess of 100. Low-pressure hydrogenation, using a nickel catalyst, is employed for the hydrogenation of octene. Actually, the operating pressure is about 75 lb. and the temperature about 325 deg. F. in the catalytic polymerization process of Universal Oil Products Co.

CATALYTIC ISOMERIZATION

Isomerization is a very important adjunct to alkylation, since the availability of normal butane from thermal and catalytic cracking for alkylation purposes is far greater than that of isobutane. The normal butane, however, was useless in alkylation until perfection of the isomerization process for converting it into isobu-

tane, from which alkylate gasoline of high octane rating can be produced. It is in this field that the aviation gasoline-synthetic rubber programs tend to conflict, as normal butane is also the chief petroleum source of butadiene.

The Shell butane isomerization process, used in conjunction with the alkylation unit, passes normal butane in vapor form and anhydrous hydrogen chloride at about 175 deg. through the catalyst, consisting of anhydrous aluminum chloride supported on a granular bed. The hydrogen chloride serves to activate the catalyst and is entirely removed from the product. The process results in almost complete conversion of normal butane to isobutane. The heat of reaction is so low that no special equipment need be used to maintain the desired temperature. The catalyst is rugged, cheaply produced and has long life so that regeneration is not necessary. It is resistant to poisoning, although it is necessary to reduce the proportions of olefins and pentanes in the charge stock to a low figure, since both these produce objectionable byproducts and tend to shorten the life of the catalyst.



One of the many ways by which raw materials for Buna S rubber, aviation gasoline and tolvol can be produced from petroleum fractions by catalytic methods

STYRENE FROM ETHYLENE

Finally, of tremendous importance in the Buna S synthetic rubber and polystyrene plastics programs, ethylene can be catalytically reacted in the liquid state with benzene in the presence of aluminum chloride (by Friedel-Crafts reaction) to yield ethyl benzene which, in turn, is converted to styrene by dehydrogenation by thermal methods or over catalysts of the copper chromite type.[3] Steam is used as a diluent to improve the equilibrium conversion. Recently[15] there has been reported a catalytic process for reaction of ethylene and benzene in the gaseous state instead of the liquid phase now used by industry. So important is styrene now that the Buna S synthetic rubber program alone, when in full swing, is said to require the production of some 234,200 tons of this material annually.[16] In contrast, only a total of some 2,200 tons of polystyrene resins were produced during 1940. Thus, outside of the synthesis of high-octane fuel, toluol, and butadiene by catalytic petroleum processes, the manufacture of styrene may soon become one of our largest industrial catalytic processes.

Most recent interest in propylene as a raw material for chemicals has centered in the Shell Development Co. process, announced in the latter part of 1940,[16] for the synthesis of glycerine by chlorinating propylene or propane and then following by hydrolysis. Caustic soda is the usual catalyst in the hydrolysis phase, while 10 percent caustic soda and one percent soda ash accomplish conversion of the glycerine monochlorohydrin to high-purity glycerine. Either alkali or catalytic cuprous chloride can be used in conversion of allyl chloride (one of the chlorination products of propylene) to diallyl ether and allyl alcohol.

This brilliant development of the Shell Development Co. places this country on an independent basis in respect to glycerine, now being used for explosives and in alkyd resins. The process is ready for large-scale production whenever the demand for glycerine or high prices would warrant further development. Williams[17] has described the process in detail.

BUTADIENE FOR BUNA

This leaves for discussion the importance of the C_4 hydrocarbons as raw materials for butadiene and for butyl rubber. There has been a great deal of confusion and political forces involved in the synthetic rubber program, most of which have revolved around the various raw materials and processes for producing butadiene. Synthetic rubbers of the Buna S type contain about 75 percent butadiene. Details of the processes, due to censorship regulations, are still not generally available.

However, in general there are four basic processes for producing butadiene that have reached either commercial or pilot plant production in this country. They are: (1) thermal cracking of mixed hydrocarbons; (2) catalytic dehydrogenation of petroleum refinery or natural gas butane and butylene; (3) catalytic conversion of ethyl alcohol, usually in several stages; (4) fermentation of grain to 2, 3-butylene glycol and conversion of this to butadiene.

The three processes actually scheduled for commercial production at this time are those of thermal cracking, catalytic dehydrogenation of butane-butylene fractions, and the Carbide process using ethyl alcohol. Although something like 100,000 tons of butadiene per year are expected to be produced from thermal cracking plants, this report will not deal with this non-catalytic process.

One of the commercial methods of producing butadiene to be used in this country starts with the butane as recovered from natural gas recycling plants or from butylene from petroleum reforming or cracking processes. Catalytic dehydrogenation of this butane or butylene fractions gives crude butadiene which must be purified by distillation or extraction processes. In the case of butane, dehydrogenation can be accomplished in two steps by the use of aluminum oxide—chromic oxide catalyst. At a temperature of about 1,100 deg. F. at atmospheric pressure, butylene is formed with liberation of hydrogen. As much as 42 percent conversion per pass has been reported. If the operating temperature is raised to about 1,200 deg. F. and the pressure reduced to 0.25 atmosphere, the butylene is dehydrogenated into butadiene. The catalyst is of the same general type as for de-

hydrogenation of butane and includes an aluminum oxide carrier coated with oxides of chromium, vanadium, molybdenum, etc.

In the Houdry combined two-stage, dehydrogenation catalytic process, the heat required for the chemical change of butane to butylene and from butylene to butadiene is furnished by burning the carbon deposit on the catalyst during the dehydrogenation stages. Regeneration of the catalyst is also accomplished by burning the carbon deposit by passing air through the mass. The useful life of the catalyst is expected to be more than six months. The crude butadiene produced by catalytic dehydrogenation is not sufficiently pure for the rubber polymerization process, and it is this purification problem that has been one of the principal difficulties in the commercial development of butadiene-base synthetic rubbers. However, it is expected that probably some 350,000 tons of butadiene per year will be produced from petroleum and natural gas C_4 fractions.

An earlier process for making butadiene involved the direct chlorination of butylene to the di-chloro compound, and then heating this in the presence of barium chloride to give butadiene and byproduct hydrogen chloride. The use of large quantities of chlorine is the outstanding disadvantage of this process.

BUTADIENE FROM ALCOHOL

One established process for the conversion of ethyl alcohol to butadiene consists of four stages; dehydrogenation of alcohol to acetaldehyde, which is then condensed to aldol; from this 1, 3-butylene glycol is produced by reduction, which in turn is dehydrated to 1, 3-butadiene.

Catalytic condensation of acetaldehyde to aldol (3-hydroxybutanal) can be accomplished by various catalysts such as aluminum hydroxide, iron or zinc oxide, or a suitable alkali. Aldol is reduced to 1, 3-butylene glycol in the presence of Raney nickel catalyst at a pressure in the neighborhood of 800 lb. per sq. in., while this glycol can be catalytically dehydrated to 1, 3-butadiene by heating in the presence of sulphuric acid at 390 deg. F. or by passing it over any one of a very large number of catalysts.

A one-stage catalytic process for this conversion involves flowing 95 percent alcohol through a heated quartz tube at about 750 deg. F. and 0.25 atmosphere pressure in the presence of a catalyst, possibly alumina for dehydration and zinc oxide for dehydrogenation.

Table IV—Typical Reaction Mixture for Buna S Rubber

Butadiene	80 parts
Styrene	20
Glue	5
Sodium alkyl naphthalene sulphonate	5
Water	100
Polymerization Agent	0.5–1.0
Orientation agent	0.5–1.0

The Publicker Commercial Alcohol Co. reports the conversion of better than 33 percent of 190-proof ethyl alcohol into butadiene by the Szukiewicz process, which consists essentially of a single pass of alcohol over a catalyst at elevated temperature. Ethylene, butylene and hydrogen are byproducts of the process. The availability of the catalyst material is one of the favored claims of this method. This process originated in Poland and is understood to be used commercially in Russia.

FERMENTATION METHODS

Another process proposes to use a fermentation reaction to produce butanol from grain, to dehydrate this alcohol to butylene, which is then dehydrogenated to butadiene. This process evidently does not appear attractive enough to be included in the present rubber program.

Another new process just announced (see page 95, this issue) involves grain fermentation with *Aerobacter aerogenes* for less than 40 hours to produce 2, 3-butylene glycol. This, however, must be separated from the "beer." One such method uses butanol as a selective solvent, followed by separation of the butylene glycol from the solvent by distillation. The 2, 3-butylene glycol can be esterified with concentrated acetic acid to form the diacetate which can then be pyrolyzed at about 900 deg. F. to give high yields of butadiene. An overall conversion of 88 percent has been obtained on pilot plant equipment. The butadiene obtained can be used without further purification in making synthetic rubber. This process has been studied by the U. S. Department of Agriculture, Joseph E. Seagram & Sons, and others. It is now in the pilot plant stage of development.

Still another process, at present not involved in the synthetic rubber program, polymerizes acetylene in the presence of cuprous chloride and ammonium chloride as catalysts and then selectively hydrogenates the unsaturated polymer to butadiene. In Germany, butadiene is obtained by synthesis from acetylene, going through acetaldehyde and catalytic reduction to 1, 3-butylene glycol as previously mentioned.

Catalytic synthesis of styrene, the other principal ingredient of Buna S rubber, has already been mentioned. In the actual polymerization of butadiene and styrene (or acrylonitrile) to form buna rubber, a mixture of the two ingredients are emulsified with water by means of soap or other wetting agent. Polymerization catalysts, usually oxidizing agents such as hydrogen peroxide, sodium perborate, ammonium persulphate or organic peroxide, are added together with an orientation agent to exert a directing influence to favor formation of linear polymers. Usually some chlorine-containing compound, such as carbon tetrachloride or hexachloroethane, is used for orientation purposes, but sodium cyanide can also be employed. The emulsified reaction mixture is usually heated at 100–140 deg. F. for 10–15 hours to complete the polymerization. A typical reaction mixture employed in the emulsion process is given in Table IV.

Butyl rubber, of which this country plans eventually to produce 132,000 tons yearly, is a copolymer containing isobutylene with some 5 percent butadiene. Polymerization is accomplished[3] by use of a boron fluoride catalyst at temperatures below 32 deg. F.

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Machinery, Materials and Products

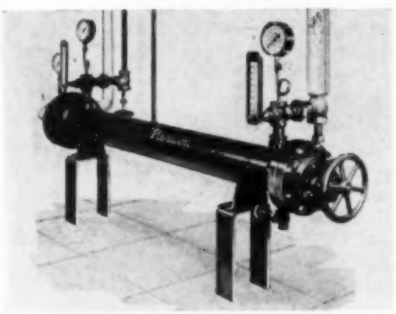
CHEM & MET PROCESS EQUIPMENT NEWS

Self-Cleaning Exchanger

READY REMOVAL of scale and sludge deposits from the tubular heat transmission elements is the feature of the Paracoil self-cleaning tubular heat exchanger which has recently been announced by Davis Engineering Corp., 1064 East Grand St., Elizabeth, N. J. As shown in the accompanying illustration, the heat exchanger is equipped with a hand wheel at one end. The shaft of the hand wheel extends through a stuffing box and is provided with a screw thread to effect longitudinal motion of the shaft. The inner end is connected to an assembly of baffles through which the U-shaped heat transfer tubes extend. The tubes, through which the heating or cooling medium flows, are connected to a divided tube sheet at the end of the exchanger opposite to the hand wheel so that both inlet and discharge connections for the tubes are made at that end.

When it is desired to clean the heat exchanger, the hand wheel is rotated so as to move the baffles a short distance longitudinally along the tubes, thus scraping the outside of each tube and loosening the solids so that they can be carried away by the flow of liquid outside the tubes. Thus it is unnecessary either to take the exchanger down for manual cleaning, or to take it out of service for one of the various solvent methods of cleaning sometimes employed. This equipment is built in various commercial sizes and in a variety of materials to resist the corrosive action of the substance being heated or cooled.

Self-cleaning tubular heat exchanger

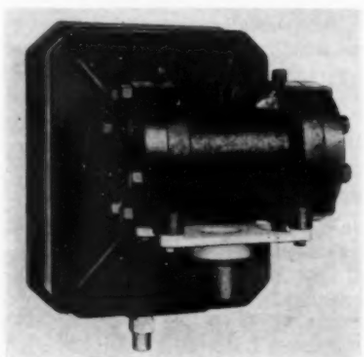


Aneroid Manometer

A MANOMETER for flow and liquid level measurement has been developed by Taylor Instrument Cos., Rochester, N. Y., which employs a metal-bellows pressure responsive element instead of the usual mercury and float system. Aside from the advantage that there is no mercury to be blown out due to line surges, the new manometer releases mercury required elsewhere for the war effort.

Instead of a stuffing box, the new instrument employs a torque tube assembly which gives a completely closed system and is designed to eliminate friction and lubrication. The metal bellows is built to withstand high over-range without damage. Under steady flow conditions the instrument is said to be accurate within 1 percent of full scale range, this type of construction being available for all manometer-type indicating and recording meters and controllers. It is built for standard ranges between 20 and 500 in. of water and the range can be changed on the job by substituting pre-calibrated torque tubes.

Aneroid type manometer

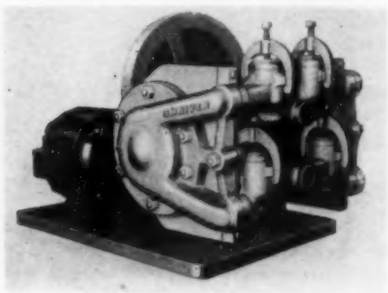


Tandem Timer

TO PERMIT practically any timing sequence that may be desired, Industrial Timer Corp., 113 Edison Place, Newark, N. J., has developed a new tandem timer which is available in six models offering settings from ¼ second to 2 hours and 45 minutes, with longer time cycles available in specially built equipment. The new equipment consists of a control unit and two timing elements. The latter are individual synchronous-motor-driven, automatic-resetting timers having a graduated dial and knob for selection of the timing period. The control cabinet is a box into which the two timers are plugged and contains the starting and repeat or single-cycle switches. It also contains single-pole, double-throw load relays controlled by the timers. In a typical set-up, the timer might control one circuit for, say, 4 seconds and the other circuit for 2½ seconds in sequence, after which it either repeats or shuts down, as desired. Pilot lights show which circuit is being energized.

New tandem timer

Diaphragm pump for heavy slurries



Openable Bag Closure

LATEST among the developments of Bemis Bro. Bag Co., 601 South 4th St., St. Louis, Mo., is the Bemis Rip-Cord closure for the closing of cotton and burlap bags, which provides a simple and easy means of opening the bags without injury. The Rip-Cord is sewn into the closure of the bag with a regular two-thread bag closing machine. Only minor, inexpensive adjustments are necessary to adapt the machine for this purpose. A quick jerk of the Rip-Cord opens the bag instantly without tearing or damaging. Not only is the new closure easier to open, but it is claimed to permit filling the bag fuller than when closure is effected by tying. Thus, ten Rip-Cord closed bags can be piled on a hand truck, whereas only eight tied-top bags can be loaded on the same truck, according to the manufacturer. As compared with a wire-tied bag, the Rip-Cord closure is said to permit using bags 2 in. smaller. The new method is thus claimed to be an important step in bag conservation.

Improved Diaphragm Pump

DELIVERY PRESSURES up to 100 lb. per sq.in., suction lifts as high as 18 ft. and capacities ranging from 1 to 100

g.p.m. are available in a new design of diaphragm pump offered by T. Shriver & Co., Harrison, N. J., especially for the handling of slurries or suspensions containing a high percentage of crystalline or quick-settling solids. The material is fed into the upper manifold through a pair of ball valves, as shown in the accompanying illustration. It then passes into the heads at each end of the pump in a clean, sweeping motion, thereby assuring that with each forward motion of the diaphragm-covered piston, the material will be forced out through the lower pair of ball valves and then through the lower manifold without an opportunity to settle in the pump head.

The principle of the pump is similar to that of this company's other diaphragm pumps, the working mechanism consisting of two double-acting pistons immersed in a bath of lubricating oil, which drive rubber diaphragms separating the material handled from the mechanism. An interesting feature of the pump is the interchangeability of the valve manifolds so that the pump may be fed at the bottom and discharged at the top, if desired.

Welders' Safety Clothing

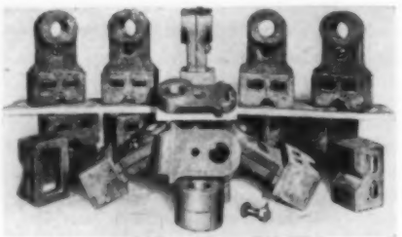
TO PROTECT welders against painful and dangerous exposure to molten metal sparks, American Optical Co., Southbridge, Mass., has developed a wide assortment of welders' safety clothing which is made of chrome-tanned leather. Among the types available are overalls, all-leather pants, aprons, coats, sleeves, gloves and various compete protection combinations. This clothing was designed by an expert welder and is made of as few pieces of leather as possible to eliminate unnecessary seams.

Level Controller

FOR THE HANDLING of all liquids at all pressures, temperatures and specific gravities, the Fisher Governor Co., Marshalltown, Iowa, has developed an improved displacement type level controller known as the Level-Trol. Greater sensitivity, higher action speed, freedom from service troubles and ease of adjustment are claimed for the new controller. This device is used not only in level control, but also for interface level control, level indication and specific gravity control. Instruments are available in five types for all service conditions, with float lengths ranging from 14 to 120 in.

Pneumatic operation is employed, all linkages, pivot points and other sources of friction being eliminated so as to reduce operating power to the minimum. A level position adjustment permits positive controlling of the level at any desired point within the length of the float while a throttling range adjustment makes it possible to vary the amount of level change necessary to move the diaphragm valve from open to closed, or vice versa. Among the new design features is a type of construction employing an Inconel torque tube to eliminate stuffing box packing and lubrication.

Welders' safety clothing



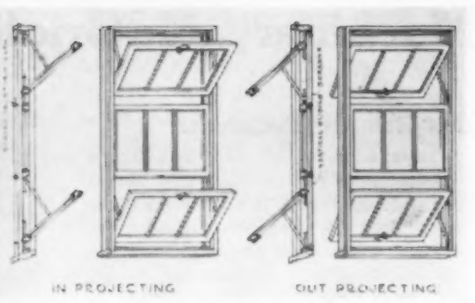
Group of renewable-tip pulverizer hammers

Renewable Pulverizer Hammers

ASSISTANCE to the metal conservation program is afforded by the new Clark renewable-tip pulverizer hammer recently announced by American Manganese Steel Division of American Brake Shoe & Foundry Co., Chicago Heights, Ill. The hammer consists of a weighted manganese steel head, connected to the rotor by two matching arms or bars of manganese steel. On the lower end of each bar is a hook which engages internal pockets in the head. The bars are bolted together under the head so as to form a one-piece arm. However, when the heads are worn the bars are easily disconnected and disengaged from the head which then is all that needs to be replaced. It is claimed that the new design saves greatly in the weight of discarded parts since about two-thirds of the hammer head can actually be used up before renewing is necessary. Furthermore, the time consumed in removing old and replacing new heads is small. The head cannot work loose and come off the arm as long as the latter is on the supporting rotor pin.

Wood Window Sash

TO PROVIDE adequate fenestration for industrial buildings despite priorities on critical materials, the National Door Manufacturers Association, 332 South Michigan Ave., Chicago, Ill., has announced the new National Projected Wood Sash which has been designed by a well-known firm of architects and engineers. The new sash is offered in 18 standard basic units, each basic unit an opening in itself. These units may be installed individually, or various units may be combined in height and width to meet any window sash requirements. The quantity of metal necessary for the hardware for one complete unit has been cut to only about 3 lb.



National Projected Wood Sash showing inward and outward projecting ventilators

All wood used is treated with a preservative against possible deterioration. All frames are completely factory fitted and all sash pre-fitted to exact size. Units are available with either fixed or movable sash, the latter being of two types, namely, bottom-pivoted for inward projection, and top-pivoted for outward projection. Since ventilators are never centrally pivoted, screening or storm sash may be easily and economically installed. Although these windows are especially designed for manual operation, various types of mechanical operating devices are available for long lines of horizontally projected ventilators.

Seal for rotating shafts

Mechanical Seal

SEALING against pressure is the function of the new Sealol mechanical seal for rotating shafts which has recently been announced by Stevenson Engineering Corp., 45 Willard Ave., Providence, R. I. The initial contact

between the sealing ring and a hardened, lapped surface on the shaft which is being sealed is accomplished by a light corrugated spring. Sealing against the pressure, however, is accomplished by the fluid pressure itself, acting upon two opposing surfaces of the sealing ring, these surfaces having been designed so that the area on the seal side is less than that on the opposite side, and hence a pressure differential is exerted to maintain fluid tightness.

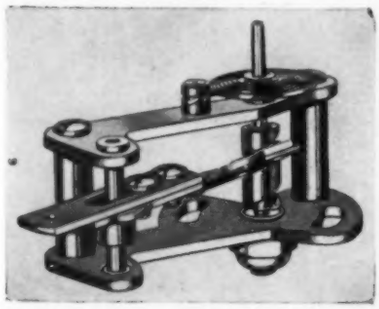
The Sealol consists of five parts, a retainer cup, a synthetic rubber packing ring which tightly seals the sealing ring to the retainer, a thrust washer, a flat corrugated spring and the sealing ring itself. The device is available for shaft diameters ranging from ¼ to 2 in. It is claimed to seal fluids over a wide range of pressures and speeds. The use of balanced pressure is said to minimize frictional heat and power loss, while the seal is claimed to exclude all foreign matter from bearings. This device is applicable to either plain or anti-friction bearings and works equally well in either direction of shaft rotation.

Portable Floodlight

ESPECIALLY for use in combustible areas which cannot have installed lighting, General Electric Co., Schenectady, N. Y., has announced a new portable battery-operated floodlight consisting of a 19x9 7/8x20¾-in. steel box to which is attached a special dust- and vapor-proof lamp housing mounted on a bracket to allow pointing in any direction. A high efficiency glass reflector, combined with pre-focus positioning of the unit's 50-cp. concentrated-filament type bulb, and a diffusive lens, gives a powerful medium-angle floodlighting distribution. Normal burning time is approximately 10 hours and the five-cell storage battery may quickly be exchanged for a charged battery through the use of a polarized connector permanently wired to the battery terminal. The unit is intended for use in such places as powder igloo interiors, powder magazines, freight car and warehouse interiors containing combustibles, and during blackouts, etc.

Battery operated floodlight

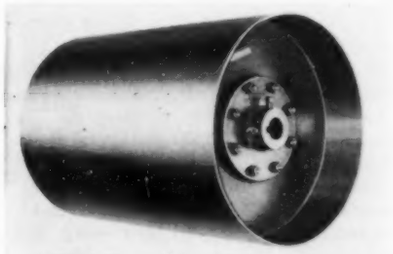
Novel gage movement



Gage Improvement

FOR USE in indicating pressure gages, Certified Gauge & Instrument Corp., Long Island City, N. Y., has developed a new type of gearing in the form of a cam and roller movement. As shown in the accompanying illustration, this movement employs a sector-shaped driving cam and a driven helical roller. One end of the pivoted cam is linked to the tip of the bourdon tube while the other end is aligned with and fits freely into the thread of the roller. A hair-spring limits the point of contact between cam and roller to only one side of each element, thus preventing back lash. The new movement is claimed to provide smooth and constant transmission of motion from the pressure element to the pointer, while at the same time preventing jamming of the mechanism in the event of over-travel of the bourdon tube. A simple adjustment is provided for easy resetting of the zero or for calibrating of the gage during use. The calibrating adjustment is effective up to one-half of the total dial length.

Tight-end conveyor pulley



Magnesium welding with Heliarc process

Conveyor Pulley

FOR USE as head and tail pulleys in belt conveyor installations, the American Pulley Co., 4200 Wissahickon Ave., Pniladelphia, Pa., has announced the new type N solid-type steel conveyor pulley which is made with tight ends so that no spilled material, dust or water can accumulate inside the pulley. These new pulleys, made in diameters ranging from 6 to 36 in., are rolled from one piece of steel and arc welded to form a one-piece cylinder. This cylinder is then closed at a point near either end by a welded-in disk to which removable, interchangeable hubs are secured by stub bolts. Thus, bores can easily be changed simply by changing the hubs. The hubs are provided with a keyway and two set screws for attachment to the shaft. The pulleys are designed for 125 lb. effective belt tension per inch of width of face. Both flat and crown-faced pulleys are available. If desired, pulleys can be provided with a vulcanized-on lagging to give greater gripping power.

Magnesium Welder

IN COOPERATION with Dow Chemical Co., Northrop Aircraft, Inc., Hawthorne, Cal., has developed the Heliarc welding process for the welding of magnesium. The new process required a two-year period of development and has now been made available to war industries. It permits the arc welding of magnesium sheets, extrusions, tubing and castings. It is claimed to overcome previous difficulties in the fabrication of this important light metal.

In addition to being a successful method of attachment for magnesium, the new welding process is said to be suitable for stainless steel, brass, Inconel, Monel and some of the carbon steel alloys. Research progress is reported on its use with aluminum and other carbon steel alloys not hitherto welded in this way. In the new process a shield of helium gas envelops the molten metal. This prevents oxidation and eliminates the use of a flux. The arc in this process is produced directly between a tungsten electrode and the base metal, rather than between two tungsten electrodes as is the practice in atomic hydrogen welding. The welding torch is equipped with a helium valve which is opened just prior to striking the arc. Since helium has over five times the specific heat of air, in motion it prevents heat accumulation around the weld, keeping it cooler and giving better fusion and penetration, with less distortion than other welding processes.

Torches have been designed for this process and will shortly be available to industry. Eventually a type will be available which feeds the filler rod automatically. The process best employs a conventional arc welding machine with a direct-current generator having a 150 amp. output, although

higher output machines which operate at less than 300 amp. may be used if lower current values are obtainable. The average life of a 200 cu.ft. helium tank is about 35 hours of continuous welding with a medium size torch. Rather pure helium must be used.

Loose Pulley Oiler

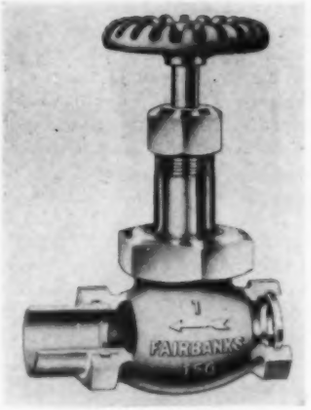
A NEW wick-type lubricator announced by Oil-Rite Corp., 3466 South 13th St., Milwaukee, Wis., has been designed specifically for the lubrication of loose pulleys, clutches and similar rotating machine parts. The oiler is constructed to deliver a constant and regulated amount of filtered oil to the shaft or bearing while the pulley is in operation and to prevent oil waste while the pulley is idle. The lubricator consists of a simple glass reservoir mounted on a hollow metal stem which is sealed from the oil in the reservoir except for two small ports at the top. Inside the stem is a cylindrical felt wick which extends through the pulley hub to rest directly on the shaft. A compression spring wrapped around the wick holds it firmly in position against the shaft. As the pulley rotates, centrifugal force throws the oil against the top of the reservoir and into the two ports in the stem, thus admitting oil to the wick which conducts it directly to the shaft. A small plug is provided, the adjustment of which regulates the area of the oil ports and thus controls the amount of oil delivered.

Equipment Briefs

INDUSTRIAL GLOVES Co., Danville, Ill., has recently perfected a type of light-weight horsehide glove designed particularly for use by women in industry. This general-purpose work glove is light and flexible, having an open back to provide coolness. An elastic web band across the opening keeps the glove snug. Three sizes are available. The new gloves may be purchased in pairs, all rights, all lefts, or in any combination of rights and lefts.

TO MEET present-day demands for explosion-proof timers suitable for operation in solvent- or gas-containing atmospheres, the R. W. Cramer Co., Centerbrook, Conn., has developed a line of instruments meeting such specifications. These instruments are available for panel board mounting with the setting knob and dial projecting, and can be provided with a small relay when it is desired to control the timer from a remote-located momentary-start button.

FOR USE in maintenance and construction work, Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., has developed a 40-ft. telescopic portable elevator which not only raises materials for installation or lowers them for removal, but also gives an elevated working platform. The lifting speed is approximately 30 ft. per min.

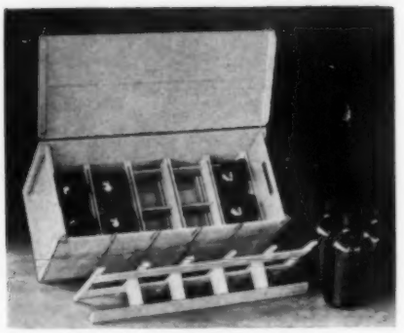


Brazed-joint valve

UNUSUALLY quick action is claimed for a new three-way valve of the butterfly type manufactured by R-S Products Corp., Wayne Junction, Philadelphia, Pa. This valve is designed for mixing and quick interchange service and is adapted to fully automatic control by means of an air diaphragm motor or hydraulic cylinder. It is built of cast steel or cast iron for pressures up to 600 lb., or various other metals may be substituted. The vane is of a special self-cleaning, double-beveled, stream-lined design which is claimed to seat wedge-tight against the body of the valve, thus producing tight shut-off as well as positive control of volume and pressure.

A NEW "GIANT" photoelectric cell of the self-generating type, having a current output of 4,000 microamp. at 100 ft.-candles illumination, and developed for light-sensitive applications in which the sensitive element is at a considerable distance from the control room, has been announced by Emby Products Co., 1800 West Pico Boulevard, Los Angeles, Cal. The unit consists of seven sensitive disks mounted in a single element 7⅞ in. in diameter. This company's photoelectric cells feature an output in excess of 450 micro-amp. per lumen and, due to a special process, are said to be permanently stable and able to withstand temperatures up to 70 deg. C. Three different sensitivity ranges are available to meet requirements in various application fields.

ACCORDING to a recent announcement of the War Department, the Chemical Warfare Service has developed a new dust respirator for military use in sandy and dusty areas which is also adaptable to industrial and peacetime uses. The new respirator is light in weight and fits snugly over the nose and mouth. It consists of a filtering felt mounted on a rubber frame with an inlet and outlet valve. There are no lenses since the respirator is intended to supplement goggles. The unit is also suitable for filtering certain kinds of non-toxic smoke.



New acid shipment box

A NEW high-wet-strength filter paper, designated as No. 755-2, has been announced by Henry E. Jacoby, 205 East 42d St., New York, N. Y. This paper is intended to be used over the filter cloth in filter presses, particularly in cases where the filter cake is to be saved. It is claimed that no trouble is encountered from lint adhering to and contaminating the cake. At present the paper is available only in widths up to 24 in.

Brazed-Joint Valve

FAIRCOSEAL is the name given to a new line of bronze valves manufactured by the Fairbanks Co., 393 Lafayette St., New York, N. Y. These feature pre-inserted rings of Sil-Fos silver brazing alloy in the port openings, instead of threads. With this feature, the valve and pipe can be easily brazed together into a one-piece piping assembly by the application of an oxy-acetylene flame. The joint so produced is said to be able to withstand tension, compression, torsion, vibration and corrosion to the same degree as the pipe or tube with which the valve is used. Suitable tube materials include copper, yellow or red brass, copper-nickel and Monel, in such services as steam, oil, hot and cold water, compressed air, certain acids, and certain refrigerants.

Acid Shipping Box

ACCORDING to the General Box Co., 510 North Dearborn St., Chicago, Ill., many producers of acids are now meeting shortages in containers by shipping their products in bottles protected by a new design of General All-Bound box. The accompanying illustration shows the flexible separators which are employed to avoid breakage. Boxes of this type are said to reduce freight costs by being light in weight. They are easily handled and save time in the shipping room, according to the manufacturer, since they are assembled without nails and come in one piece, saving storage space because they are stored flat.

Accurate Processing Important
to Vital War Materials

SYNTHETIC RUBBER
OIL PRODUCTS
CHEMICALS
PLASTICS

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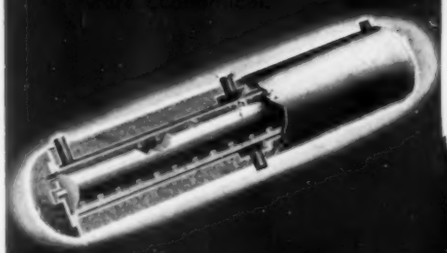

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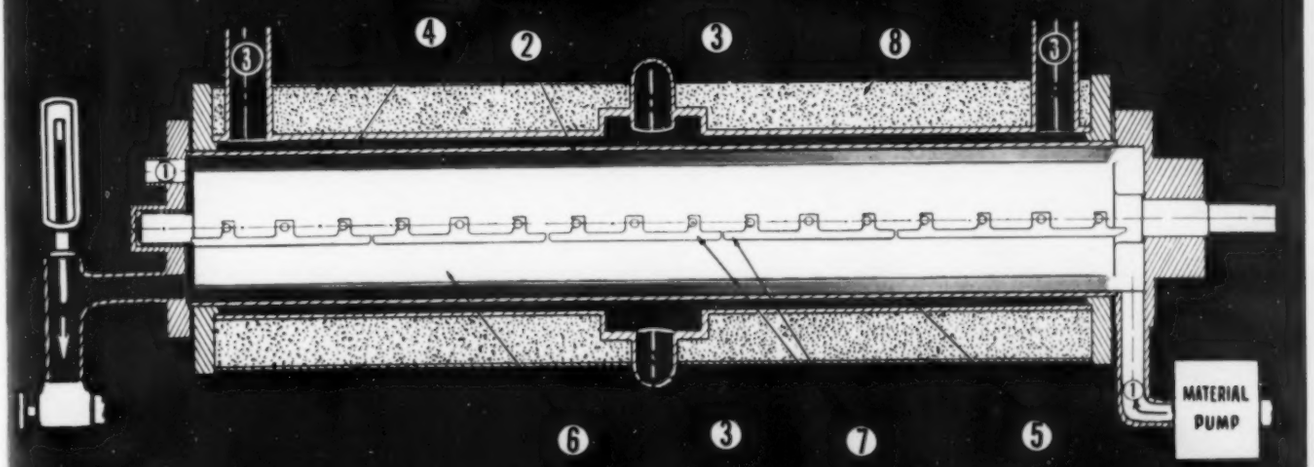

VOTATOR

Continuous Production of Viscose Rayon

More than 60 percent of all rayon produced in this country is made by the viscose process. The conventional methods use either the pot or spool system requiring frequent manual handling of the yarn. After some years of experimentation, the Industrial Rayon Corp. developed a method for production on a continuous basis and built a plant at Painesville, Ohio, with a capacity of 20,000,000 lb., which represents an investment of more than $15,000,000.

In the chemical department, the new plant is essentially similar to other viscose plants. As far as possible, it has been laid out to permit gravity flow. On the fourth floor of the chemical building, sulphite wood pulp sheets are treated in steeping presses with a solution of caustic soda. Handling of the pulp sheets to the presses and from the presses to the shredders, is accomplished with overhead monorail carriers which are also used in dumping the alkali cellulose crumbs from the shredders to the ripening room below. On the second floor are the jacketed xanthating churns to which the ripened alkali cellulose is chuted by gravity. After the treatment with carbon bisulphide in the churns the contents are discharged through chutes to dissolvers on the first floor in which the xanthate is dissolved in additional caustic soda solution. From the dissolvers the viscose flows by gravity to steel ripening tanks in the cellar beneath the spinning room. During the ripening period the viscose receives several filtrations in plate and frame filters, after which it is forced by air pressure to individual filter presses associated with each spinning machine.

Whereas the usual bobbin spinning machine serves only for the extrusion and coagulation of the yarn filament—and the pot spinning machine adds only the twisting operation—the new continuous machine developed by Industrial Rayon, also washes, desulphurs, bleaches, lubricates, dries and twists the yarn without more than routine attention from the operators. In addition it can deliver sized or tinted yarn if desired. Thus, the new process compresses into about six minutes (the time required from spinnerette to dried, twisted yarn), operations which in other viscose plants require up to 90 hours.

CHEMICAL & METALLURGICAL ENGINEERING

October, 1942

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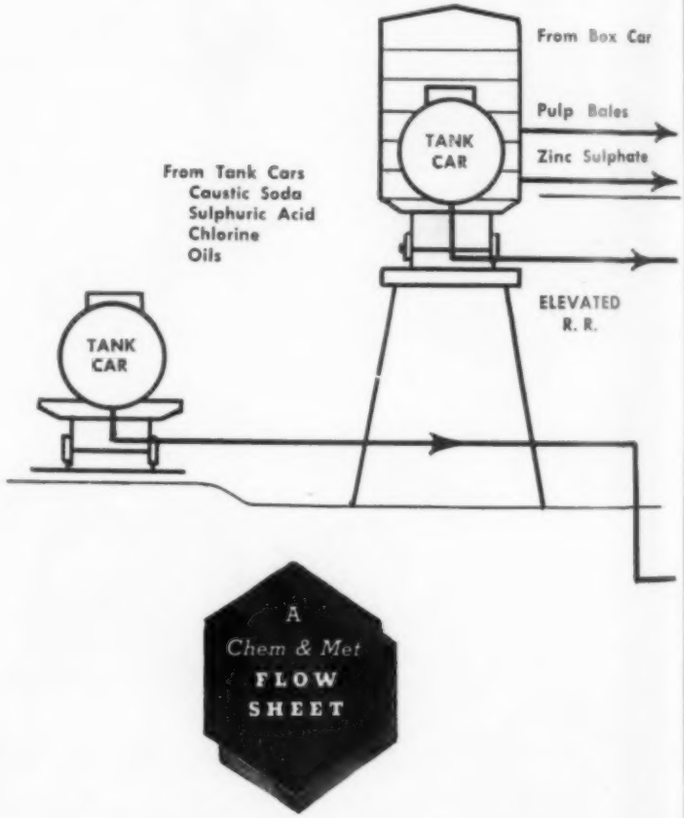
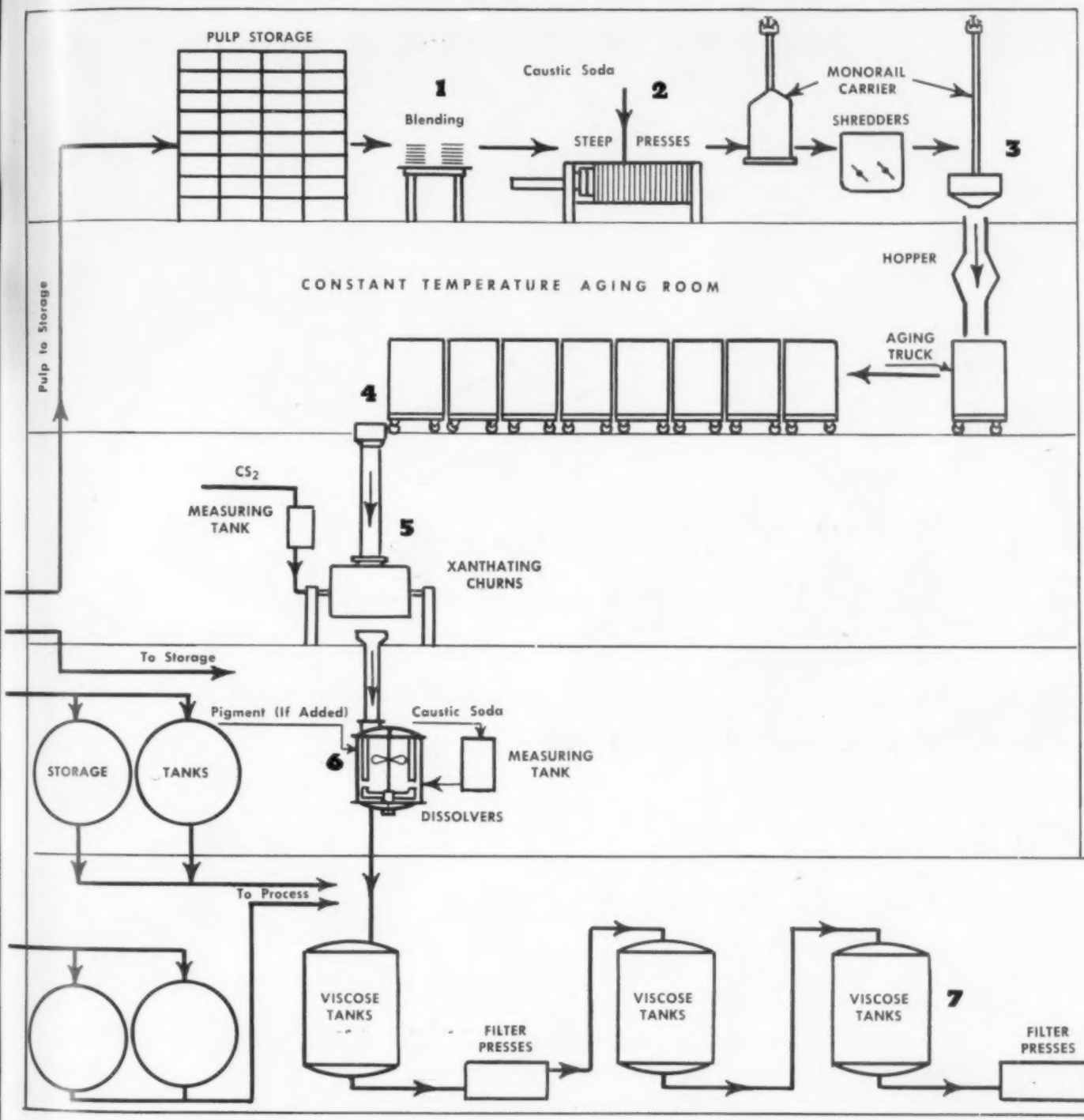
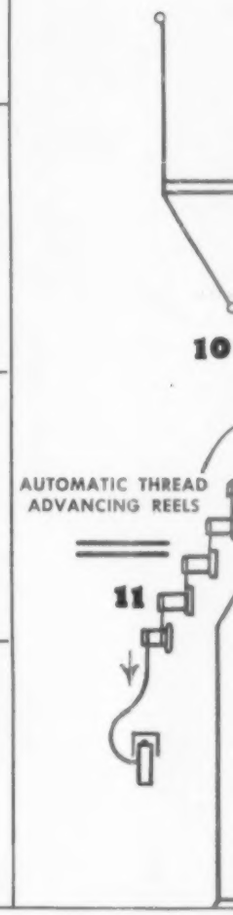
1 Sheets of wood pulp are selected from various shipments to obtain uniformity in this the principal raw material for viscose rayon



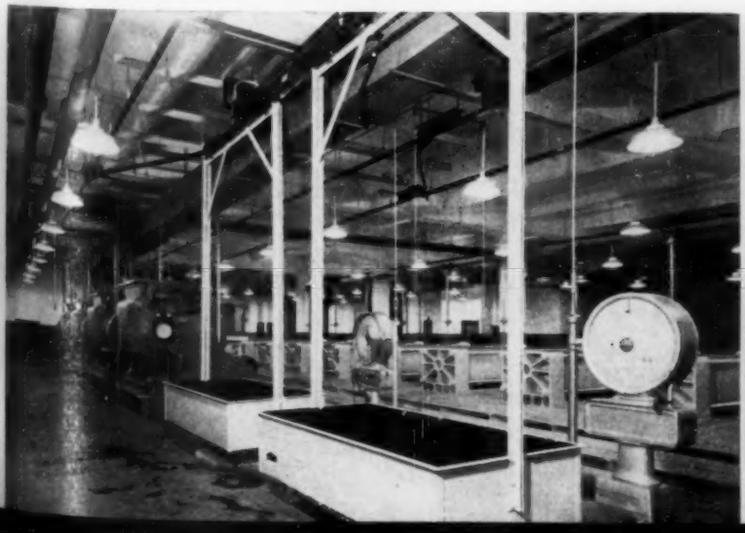
A *Chem & Met* FLOW SHEET

2 Blended sheets of wood pulp are distributed in a steeping press and soaked in a solution of caustic soda to make alkali cellulose



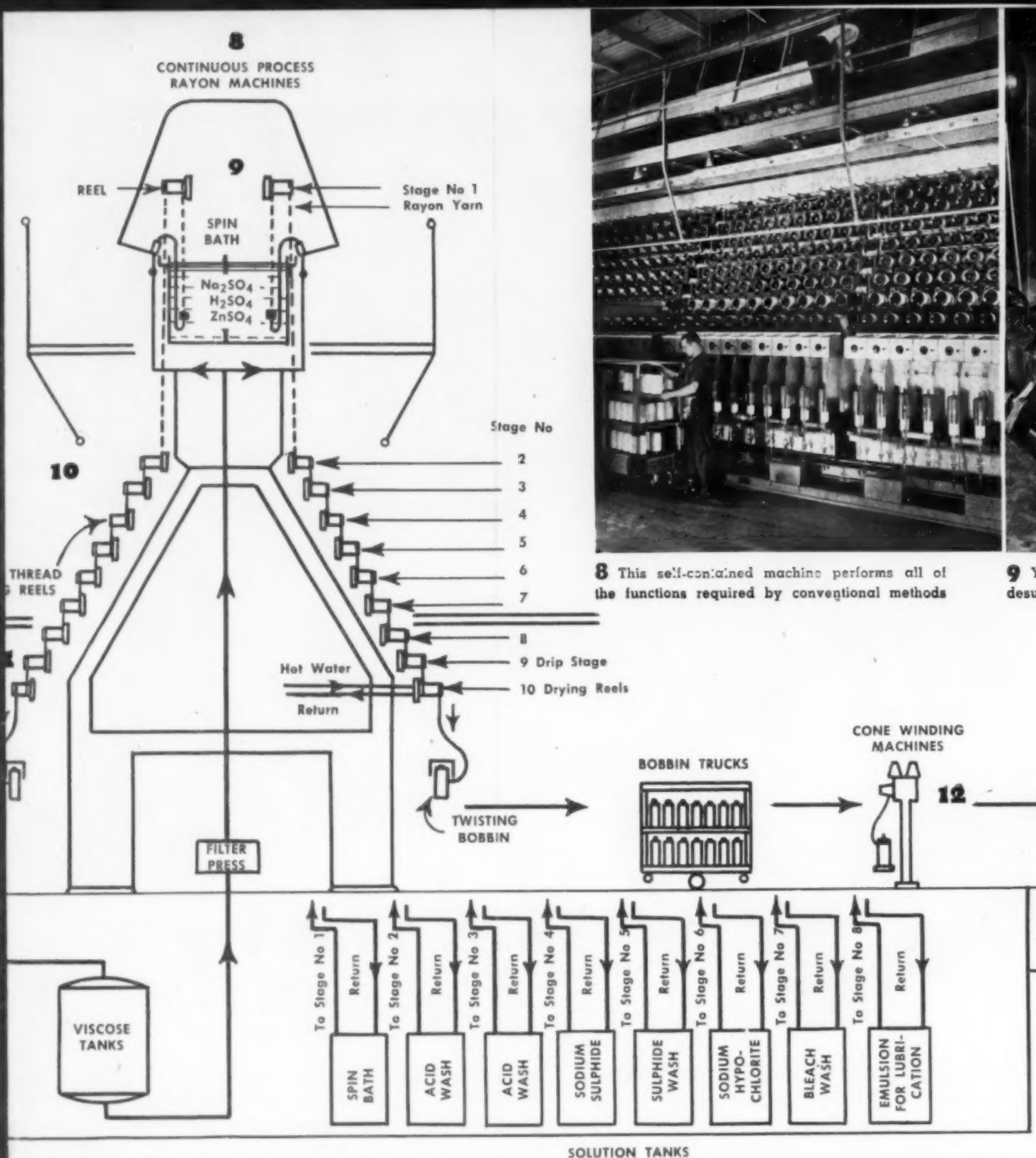


3 Top floor of chemical building showing scales for cellulose, steeping presses in rear, shredders, and monorail conveyors



4 After ripening in steel bins, crumbs are dropped through a floor chute to next stage

5 On the second floor are the jac ripened alkali cellulose is chuted by

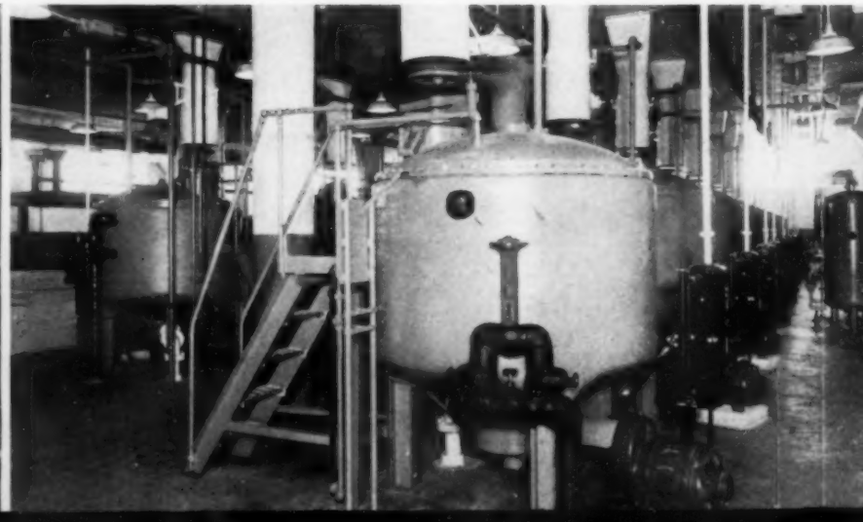


8 This self-contained machine performs all of the functions required by conventional methods

9 Yarn passes down f desulphured, bleached,

e the jacketed welded steel xanthating churns to which the chuted by gravity and treated with CS_2

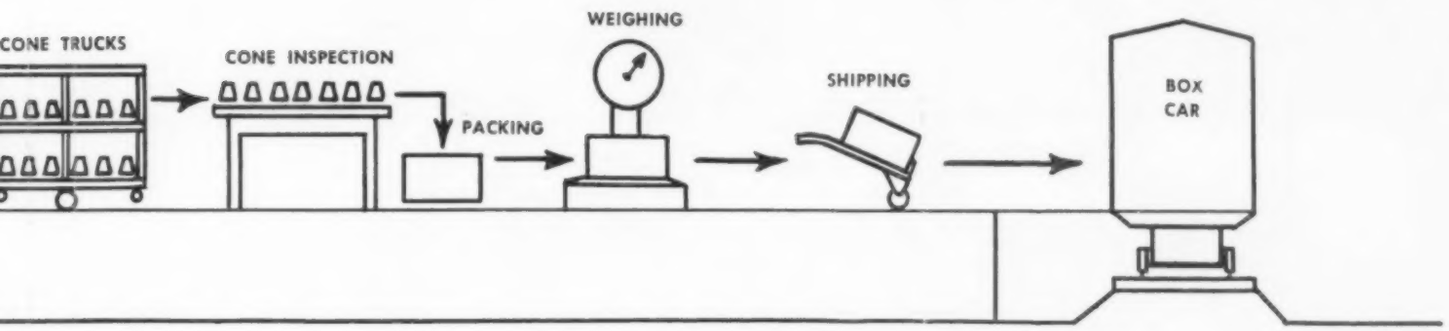
6 Churns in turn discharge through chutes to the Patterson dissolvers on the first floo in which the xanthate is dissolved in additional caustic soda solution



asses down from spinning reels to be washed, d, bleached, lubricated, dried and twisted

10 Yarn spun at the top of continuous spinning machines is processed as it moves over terraced reels

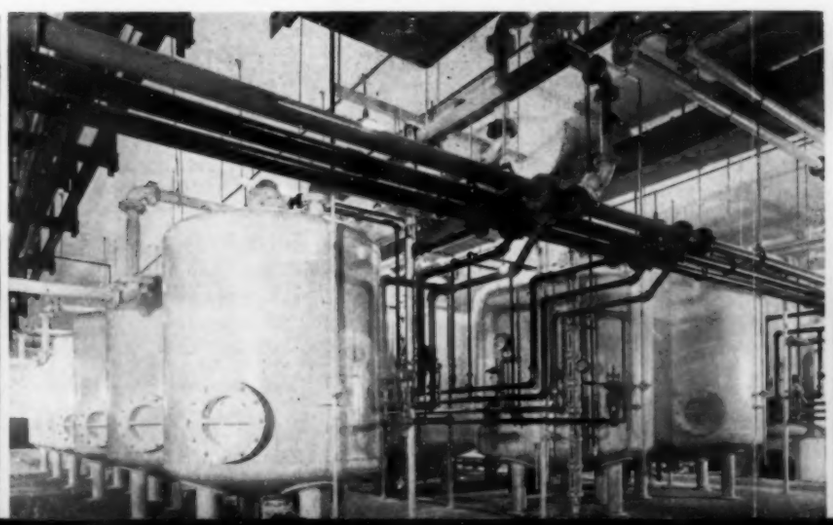
11 Behind circular windows (shown here) are heated reels upon which yarn is dried



the first floor

7 From the xanthate dissolvers the viscose flows by gravity to the welded steel ripening tanks in the cellar beneath the spinning room

12 Yarn goes from the spinning room direct to coning machines like these for winding



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CHEM & MET NEWS

ENGINEERING GROUP TO ORGANIZE OFFICE OF TECHNICAL DEVELOPMENT

APPOINTMENT of a committee of engineers and scientists to determine the manner in which the projected Office of Technical Development should be dealt with within the War Production Board, and to define the scope, functions and method of operations which the office should have, was announced recently by Chairman Donald M. Nelson.

Decision to establish such an Office of Technical Development was made earlier, following a report by a previous committee recommending that the War Production Board set up a strong scientific and technical organization to make sure that the nation's technical ability and resources were utilized to the full in the war production program.

Chairman of the new committee is Webster N. Jones, Director of the College of Engineering, Carnegie Institute of Technology at Pittsburgh. Other members are: Dr. Lawrence W. Bass, Director of Research, New England Industrial Research Foundation, Boston; Dr. Oliver E. Buckley, President, Bell Telephone Laboratories, New York; Col. Clarence E. Davies, Ordnance Department, U. S. Army, Washington; Dr. Ray P. Dinsmore, Manager, Development Department, the Goodyear Tire & Rubber Co., Akron, Ohio; Admiral J. A. Furer, U. S. Navy, Washington; Dr. Jerome C. Hunsaker, Head of the Departments of Mechanical and Aeronautical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.; H. W. Graham, Director of Metallurgy and Research, Jones & Laughlin Steel Corporation, Pittsburgh; S. D. Kirkpatrick, Editor of *Chemical & Metallurgical Engineering*, New York.

The Office of Technical Development, as outlined some time ago, will devote itself to checking the feasibility of various suggestions by inventors and scientists on subjects other than actual armament. Suggestions will be sifted through other technical agencies before being presented for examination of the O.T.D. An appropriation of $150,000,000 with which the office may finance the building of prototype models has already been asked of the Budget Bureau by the War Production Board. The funds will also be used for constructing pilot plants for testing new processes to speed up production of synthetic rubber or any other manufacturing operation.

DRUGS AND COSMETICS SECTION FORMED IN WAR PRODUCTION BOARD

PERSONNEL of the new Drugs and Cosmetics Section of the Chemicals Branch of War Production Board was announced recently by Dr. E. W. Reid, Chief. Section Chief is F. J. Stock, who was Deputy Chief of the Health Supplies Branch until his transfer to the Chemicals Branch. He was formerly with the Walgreen Drug Co., Chicago.

Deputy Chief of the new section is C. A. Willard, former Chief of the Cosmetics Branch. Consultants are Floyd Thayer, Dr. A. B. Pacini, John Williams and Dr. Dan Dahle. Unit chiefs are as follows: Biological and Medical Chemicals Units, J. T. Batson; Botanicals and Imports Unit, T. F. Currens; Vitamins and Agar Unit, Mark Merrell; Cosmetics Unit, Robert Blair.

The Drugs and Cosmetics Section of the Chemicals Branch has taken over the functions previously performed by the Drugs and Pharmaceuticals Section of the Health Supplies Branch and by the Toiletries and Cosmetics Branch of W.P.B.

ALCOHOL PRODUCTION SUFFICIENT FOR WAR NEEDS

ALL THE ALCOHOL necessary for smokeless powder, mustard gas, medical needs and an adequate supply for synthetic rubber is being produced. The quota of this essential war material for 1942 is 240,000,000 gal. So reports Howard T. Jones, secretary-general counsel of the Distilled Spirits Institute, trade association of the liquor industry.

It was pointed out that facilities of the industry for producing alcohol were offered to the government prior to Pearl Harbor and accepted some time afterwards. The conversion has been completely voluntary. In fact, the War Production Board has not issued a single order or directive to the distilled spirits industry nor is any such order expected before 100 percent conversion, which is scheduled for November 1.

By making alcohol from grain, the distilling industry's plants are saving some 1,200,000 tons of sugar in 1942. During this year some 100,000,000 bushels of surplus grain will be used by the industry in the making of alcohol. The alcohol to be made by the distillers from grain will produce 200,000 tons of synthetic rubber, or nearly one-fourth of the 870,000 tons of synthetic rubber now scheduled.

The War Production Board's 1943 quota for the distilled spirits industry is 240,000,000 gal. of alcohol out of a total of 530,000,000 gal. from all sources. Of the remainder, 225,000,000 gal. is to be produced by the industrial alcohol industry, partly from grain and partly from blackstrap molasses, and 65,000,000 gal. synthetically from petroleum industry byproducts. In order to produce this 240,000,000 gal. of alcohol, the distilled spirits industry will require 100,000,000 bushels of grain.

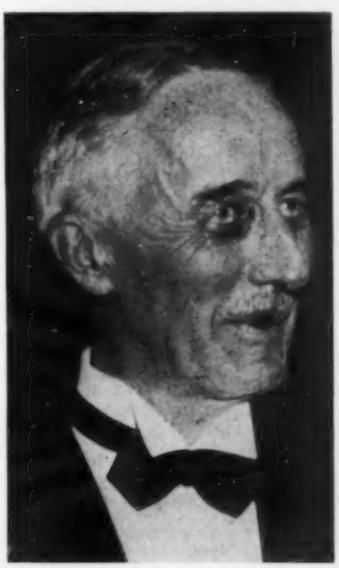
It was pointed out that by converting its facilities to the production of alcohol with the minimum use of critical materials, the industry has made available for direct war production a tremendous volume of copper and steel. To duplicate the industry's alcohol capacity would require 55,000 tons of steel plate, 79,000 tons of structural steel, 7,000 tons of copper and 400 tons of bronze, according to War Production Board estimates.

ELECTROCHEMICAL SOCIETY AWARDS ACHESON MEDAL TO BURGESS

DR. CHARLES Frederick Burgess, well known throughout the world as the inventor of the standard Burgess battery, has been awarded the Edward Goodrich Acheson medal and $1,000 prize by the Electrochemical Society. The Acheson medal and prize, highest award in the field of electrochemistry, was established some years ago by Dr. Acheson of Niagara Falls, inventor of artificial graphite and carborundum.

Dr. Burgess is the seventh recipient, previous recipients being Dr. Acheson, Edward F. Northrup of Princeton (induction furnace), Colin G. Fink of Columbia (electrochemistry), Frank J. Tone, of Niagara Falls (electrothermics), Frederick M. Becket of Niagara Falls (ferro-alloys) and Francis C.

Dr. Charles F. Burgess, recipient of the Electrochemical Society Acheson medal and prize



Frary of New Kensington, Pa. (electrometallurgy).

Dr. Burgess is the inventor of numerous and highly diversified products and processes: dry cell, electrolytic iron, sterilizing with chlorine, wood conservation, etc. He is a director of the Burgess Battery Co., Burgess Cellulose Co., Burgess-Parr Co. and the Thordarson Electric Mfg. Co. In England his interests are represented by the Burgess Products Co., Ltd. and the Burgess Zeolite Co., Ltd. Dr. Burgess' winter home is on Burgess Isle, off the West Coast of Florida, where he spends a large part of his time in his own personal laboratory.

DEWEY APPOINTED DEPUTY RUBBER DIRECTOR

APPOINTMENT of Col. Bradley Dewey, Cambridge, Mass., as Deputy Rubber Director was announced recently by Rubber Director William M. Jeffers.

Colonel Dewey is associated with Dewey and Almy Chemical Company, one of the pioneers in synthetic rubber research in the United States. It was the second company in this country to use rubber latex on a commercial scale and one of the first to substitute synthetic rubber for the natural product. In 1938, Colonel Dewey visited many of the leading European rubber factories and laboratories and returned to the United States to start intensive research in Buna S rubber. Materials to erect a synthetic rubber plant with its own funds were granted the company in December, 1941, and the plant went into operation in August.

Holder of the Distinguished Service Medal for his work as chief of the Gas Defense Division of the Chemical Warfare Service in World War I, Colonel Dewey has served as a CWS consultant since. He also is a consultant on rubber problems to the Army Quartermaster Corps. He is a life member of the Corporation of Massachusetts Institute of Technology and a member of many scientific societies.

OPERATING STAFF FOR REFEREE BOARD ANNOUNCED

THE OPERATING staff for the Referee Board of the Chemicals Branch, W.P.B., has been announced by Dr. Donald B. Keyes, Chairman. Dr. Lawrence A. Monroe, Philadelphia, has been named executive secretary to the board, assisted by Dr. W. M. Langdon, of Elizabeth, N. J. They will devote full time to the work.

Cooperating on a part-time basis will be Dr. Carl Monrad, Dr. A. L. Elder, Dr. C. W. Lenth, E. M. Houts and Walter Munster. These men are now officials of the Chemicals Branch in various capacities and will take on the work of the board in addition to their present duties.

These staff members will collect data on various problems for submission to the board and will make preliminary reports on problems submitted to them. The Referee Board is composed of 12 chemists and chemical engineers who report their findings as to the merits of competing chemical processes submitted to the W.P.B. and act in an advisory capacity in assigning raw material research problems to various laboratories located throughout all parts of the country. Assignments will be determined by consideration of all factors involved.

For Production Excellence

Among those companies that have already been awarded the honorary Navy "E" and joint Army and Navy "E" burgee for exceeding all production expectations in view of the facilities at their command, are included the chemicals and explosives plants, the chemical process industries and the chemical engineering equipment concerns listed below. Other process and equipment plants will be mentioned in these columns as the awards are presented to the individual plants themselves.

Chemicals and Explosives

Abbott Laboratories, N. Chicago, Ill., and New York, N. Y.
E. I. du Pont de Nemours & Co. (Indiana Ordnance Works), Charleston, Ind.; (Neoprene Plant, Rubber Chemicals Division), Deepwater, N. J.
Humble Oil and Refining Co. (Baytown Ordnance Works), Baytown, Tex.
Barium Reduction Corp., South Charleston, W. Va.
Hercules Powder Co., Radford, Va.
Hooker Electrochemical Co., Niagara Falls, N. Y.
Victor Chemical Co., Mount Pleasant, Tenn.
Strontium Products Co., Chauncey, Ohio.
Western Cartridge Co., East Alton, Ill.
International Flare Signal Division, Kilgore Manufacturing Co., Tipp City, Ohio.
Climax Molybdenum Co., Climax, Colo., Langeloth, Pa., Detroit, Mich.
E. R. Squibb & Sons, New York, N. Y., New Brunswick, N. J., and Brooklyn.
Monsanto Chemical Co., (Monsanto, Tenn., and Anniston, Ala.), St. Louis, Mo.
Trojan Powder Co., Seiple, Lehigh County, Pa.
Picatinny Arsenal, Dover, N. J.
Couse Laboratories, Newark, N. J.
National Carbon Co. (Clarksburg Plant), Clarksburg, W. Va.
Vanadium Corp. of America, Bridgeville, Pa.
Goodyear Engineering Corp. (Hoosier Ordnance Plant), Charleston, Ind.
Electro Metallurgical Co., Niagara Falls, N. Y.
Linde Air Products Co. (Sapphire Plant), East Chicago, Ind.

Chemical Process Industries

Chemurgic Corp., Richmond, Calif.
Aluminum Co. of America (Garfield, N. J. plant)
Firestone Rubber and Latex Products Co., Fall River, Mass.
Firestone Tire and Rubber Co., Akron, Ohio.
Goodyear Tire and Rubber Co. (Plant No. 3), Akron, Ohio.
Hammermill Paper Co., Erie, Pa.
Southern Chemical Cotton Co., Chattanooga, Tenn.
American Lava Corp., Chattanooga, Tenn.
Tyer Rubber Co., Andover, Mass.
Victory Plastic Co., Hudson, Mass.
H. L. Crowley & Co., West Orange, N. J.
National Zinc Co., Bartlesville, Okla.
American Smelting and Refining Co. (Hayden Branch), Hayden, Ariz.
Revere Copper & Brass Inc., Chicago, Ill.
Rustless Iron & Steel Corp., Baltimore, Md.
Inspiration Consolidated Copper Co., Inspiration, Ariz.
Magma Copper Co., Superior, Ariz.
Miami Copper Co., Miami, Ariz.
Kennecott Corp., Nevada Consolidated Corp., Ray, Ariz., Utah Copper Co., Bingham, Utah.
American Rolling Mill Co., Middletown, Ohio.
International Smelting & Refining Co., (Miami Plant), Miami, Ariz.
American Zinc Co. of Illinois (Monsanto Plant), Monsanto, Ill.

Chemical Engineering Equipment

Whittington Pump & Engineering Co., Indianapolis, Ind.
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., and Wabash, Ind.
Borg-Warner Corp., Bellwood, Ill.
A. O. Smith Co., Milwaukee, Wis.
Struthers Wells-Titusville Corp., Titusville, Pa.
Tube Turns, Inc., Louisville, Ky.
Combustion Engineering Co., Chattanooga, Tenn.
National Tube Co. (Christy Park Works), McKeesport, Pa.
H. K. Porter (Locomotive Div. and Process Equip. Div.).
Worthington Pump & Machinery Corp., Holyoke, Mass.
Erie City Iron Works, Erie, Pa.
Builders Iron Foundry, Providence, R. I.
Chain Belt Co., Milwaukee, Wis.
Vilter Manufacturing Co., Milwaukee, Wis.
Norwalk Co., South Norwalk, Conn.
Sharples Corp., Baltimore, Md.
Weston Electrical Instrument Corp., Newark, N. J.
Phelps Dodge Corp. (Morenci Branch), Morenci, Ariz.; (United Verde Branch), Jerome, Ariz.; (New Cornelia Branch), Ajo, Ariz.
General Steel Castings, Commonwealth Plant, Granite City, Ill.; and General Steel Castings Corp., Eddystone, Pa.
Westinghouse Elec. & Mfg. Co., Baltimore, Md.
Duriron Co., Dayton, Ohio.
H. K. Porter Co., Pittsburgh, Pa.
Leeds & Northrup Co., Philadelphia, Pa.
Towmotor Co., Cleveland, Ohio.
American Machine and Metals, East Moline, Ill.
Buffalo Pumps, Inc., North Tonawanda, N. Y.
Byron Jackson Co., Los Angeles, Calif.
American Blower Corp., Detroit, Mich.
Grove Regulator Co., Oakland, Calif.
General Electric Co., Schenectady, N. Y.
Bausch & Lomb Optical Co., Rochester, N. Y.
Ohio Injector Co., Wadsworth, Ohio.
Carrier Corp., Syracuse, N. Y.
De Laval Steam Turbine Co., Trenton, N. J.
Fulton Syphon Co., Knoxville, Tenn.
Babcock & Wilcox Co. (Barberton Works), New York, N. Y.
S. F. Bowser & Co., Fort Wayne, Ind.
Fostoria Screw Co., Fostoria, Ohio.
Handy & Harman, Bridgeport, Conn.
Bethlehem Foundry & Machine Co., Bethlehem, Pa.
Jenkins Bros., Bridgeport, Conn.
Vilter Manufacturing Co., Milwaukee, Wis.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

MANPOWER is the next big hurdle for war production, and the surge of this problem to the forefront is almost directly in inverse ratio to the extent that maldistribution of materials is being whipped. The manpower situation is already at crisis stage in both non-ferrous metal mining and agriculture; no later than next spring it will wrack the entire production machine.

Manpower Problems

Up to now, Washington has only picked at the manpower problems from the outside, in the absence of clear-cut authority to allocate men to jobs. There is some chance that Washington will anticipate the manpower problem with legislation before the situation becomes so acute that only another Baruch report can clear the atmosphere for public acceptance of anything. Donald Nelson, for one, is plugging for this approach.

The most certain thing in the picture early in October is that manpower allocation is the next big issue before Congress. Several "trial balloon" bills had reached the Congressional hopper by the end of September and the hearings before the House Agriculture Committee accentuate the growing concern. Administrative policy on whether to throw manpower to War Manpower Commission Chairman McNutt or Selective Service hadn't jelled, however.

Army Manpower Requirements

Any approach to manpower allocation at this time must start from the premise that virtually every able-bodied man between 18 and 45 is going to be in uniform by the spring of 1944. The arithmetic of the situation supports this conclusion—there are 27½ million men in the 18-45 age bracket and draft experience indicates that between 13½ and 14 million of these can pass the Army physical examination.

It is important to realize that the present rate of inductions and enlistments is actually at a pace which will achieve the 13-million-man goal within less than 18 more months.

Manpower allocation legislation doesn't necessarily alter this picture. It is true that, as yet, Washington has not met head-on the issue of determining the most effective ratio of men at the fighting front and men on the production front, but the plans of the military to build a maximum uniformed force are proceeding without effective challenge.

Occupational Deferments

Selective service is now in the transition period from single to married men. The order in which men, by classes, will be called from here on has not changed materially and is not likely to; the change is almost entirely one of speeding up and enlargement of the objectives. Those classified 3-A (that is, not working in industries certified as essential and without children) will go first, then those without children who are classified 3-B (this includes those in chemical plants). Fathers of one child in 3-A will follow, beginning probably by mid-1943 or early fall, then those in 3-B, and so on.

Occupational deferment is still in the picture, of course, and chemical companies by virtue of their essential classification can expect some time to train replacements for essential employes. Once a man with dependents is reclassified into 1-A status, the tests for getting him a 2-A or 2-B occupational deferment remain: Is he a critical man in an essential industry?

Occupational deferment, however, is becoming harder to get; the chances of more than one deferment are diminishing for many types of work and there is no certainty that even initial deferments will be for the maximum period of six months, as has been customary. Draft boards inevitably will consider a shorter time necessary for training a replacement than employers—in some cases they may take to pointing out that the Army is training airplane mechanics in three months.

This strictness is not only inevitable because of the crush upon local boards to meet quotas, but also will become essential when—as it will soon—all voluntary enlistment is halted. Such a step will increase materially the requirement for obtaining skilled and technical men through selective service, particularly for the Navy and for the special Army branches.

As the draft digs deeper and deeper into the reservoir of eligibles, it may force an overhauling of the deferment procedure from an individual to a plant basis. Selective Service is studying a so-called "manning table" program in which the manpower situation is outlined on a plant basis—how many men of what skills must be retained to keep the operation going, how fast can replacements be trained, etc. The way it would work is this: Take a chemical plant with a dozen highly skilled chemists, five of them within draft ages. The plant is determined to need only 10 chemists, therefore, no deferment at all is granted the first two men called. A schedule would be worked out with management (and union) for training replacements so that the others could leave in, say, six, eight and 10 months respectively.

But whether this procedure or another is finally adopted, all signs indicate that whoever allocates manpower will consider that less men are required to run a plant and less time is needed to train replacements than any "norm" of the past. Washington makes no bones about warning management that just as it has had to devise substitutes for materials and to learn how to get along with less, soon it will have to accustom itself to the same stringencies in manpower.

Trade Agreement for Fats and Oils

The United States and Great Britain have reached an agreement as to who shall buy where in order not to bid against each other in the purchase of fats and oils. The United States is to be the exclusive purchaser of all oil seeds, oils and fats in both the North and South American continents including the Caribbean Islands, but not including the animal fats from Argentina and Uruguay. The U. S. Area includes the copra in Tahiti and all the Free French Pacific Islands, and all the oil seeds and oils and fats in Portugese Africa, Spanish Africa, and Liberia. The United Kingdom is to be the exclusive purchaser of the animal fats of Argentina and Uruguay, the oil seeds and fats and oils of all British Empire countries except those in the American Continents. Free French Africa and the Belgian Congo are also included in the British purchasing area.

Supplies of Fats and Oils

The Department of Agriculture has estimated that the total United States production of oils and fats for the year beginning July 1, 1942, will be 11.6 billion pounds, a gain of 2.0 billion pounds over the previous year. Imports during the same period are estimated at one billion pounds less than the previous year. In spite of the net increase in supplies indicated by these figures some restrictions on the use of fats and oils in this country are necessary to make the supply go around and to provide for emergency stockpile. Action along this line was taken during the last month even before the report of the Combined Food Board was made public.

Early in September an additional 25 per cent of the stock of coconut, babassu and palm kernal oils were frozen in the hands of persons with 240,000 pounds or more. This continued an earlier effort to stretch the supply of the high lauric acid oils as far as possible since it is evident that these stocks will not be augmented by new supplies from offshore sources for some time.

Late in September castor oil was put under complete allocation to insure that it goes only for the most urgent uses. Dehydrated castor oil is growing in importance as a drying oil to be used as a substitute for tung oil in protective coatings. Monthly allocation begins Nov. 1. Applications on Form PD-600 must be made before the 15th of the month preceding the month in which delivery is desired.

Another action late in the month was the overhauling of Order M-71 which establishes utilization restrictions over fats and oils with the exception of cocoa butter, butter, wool greases, essential oils, mineral oil, vitamin-bearing oils and some others. By the terms of the order manufacturers are restricted in their use of fats and oils to a percentage of their normal consump-

tion for certain products specified in Schedule A accompanying the order.

Class of use:	*Permitted percentage*
Manufacture of margarine	110
Manufacture of other edible finished products, including shortening, mayonnaise and salad dressing	90
Manufacture of soap, exclusive of soap made from domestic vegetable oil foots or their fatty acids	90
Manufacture of soap from foots made from domestic vegetable oils or their fatty acids	119
Manufacture of paints, varnishes, lacquers and all other protective coatings	80
Manufacture of linoleum, oilcloth, and oil or oleo resinous coated fabrics, and pyroxylin coated fabrics	70
Manufacture of printing inks, including lithographing, offset, silk screen, and other processing inks	90

There is ample crushing capacity in the South to handle the crop of cotton seed but the unprecedented yield of peanuts which must be handled by the same equipment, will tax its capacity. In the North there is insufficient crushing capacity for the soy bean crop and some of it will be shipped to the west coast to feed the plants that in former years processed oil nuts shipped in from the tropics.

In the meantime, the fat salvage drive seems to be bogging down although it is still too early to determine the result with accuracy. One result seems to be that the housewife, instead of making the most use of the fat saved in the kitchen, is taking it to the market and then buying lard or other shortening to take its place. The net gain is zero.

But even if the estimate of the domestic fat salvage drive should prove to be pessimistic it is doubtful if household fat can be considered a dependable source for very long. Bacon, the greatest source, is becoming a scarce article in spite of a record hog crop. Since bacon does not demand refrigeration it is in great demand for Lend-Lease shipment.

All of which adds up to the paradox of a record crop of both animal and vegetable oils and a domestic shortage.

Fufural Solvent

WPB is stockpiling as large a portion of current production as possible of both furfural and dichlorethyl ether in anticipation of heavy, although partially temporary, demands for both solvents next year to supply the butadiene program. Both products have been placed under complete allocation control of WPB's Chemicals Branch—furfural by Order M-224 and dichlorethyl ether by Order M-226, both effective as of Oct. 1. Furfural was exempted by OPA from price ceilings to stimulate new production which might prove to be high cost.

Estimates indicate that 1943 requirements of furfural will be five times as great as 1942 demands. Principally this sharp increase will come from the new butadiene plants which alone will require three times 1942 consumption. Initial requirements are much greater than the continuing replacement supply, however, so that 1943 is expected to be the "bottleneck" period. Additional plant facilities to turn out 24,000,000 pounds of furfural annually are being built with Defense Plant Corp. funds and are expected to be ready by April 1, 1943. This capacity, plus existing capacity, is expected to be sufficient to supply the entire rubber program and normal needs after the initial requirements are met.

Also in the case of dichlorethyl ether, initial demand is greater than the continuing requirement for butadiene purification, so that the acute shortage period will be during the time when the rubber plants are getting underway.

The trend toward putting all basic raw materials under full WPB allocation controls extended, in the chemical field, beyond these two vital components of the synthetic rubber program, however. At least a half-dozen other important chemicals were subject of allocation orders during September. Among them are all glycols (M-215) which WPB intends to channel in increased amounts into cigaret manufacturing so as to release more urgently needed glycerine for explosives production.

Voluntary Enlistment of Key Men

A joint Army-Navy recruiting policy put into effect in September closes the door to voluntary enlistment or commissioning of key executive and technical personnel of essential industries except where employers consent.

Under the regulation, civilians in key positions will neither be accepted for enlistment nor granted commissions without written release from employers. Other workers in listed industries require written permission from draft boards to go into service, and employers may appeal local board releases just as they do in occupational deferment cases.

The policy applies to all branches of the chemical and metallurgical industries, as well as to other lines of work which have been certified by Selective Service as essential to or in support of the war effort. For practical purposes, employes in occupations listed in Bulletin No. 10 covering the chemical industry are those requiring release from employers, those in other occupations are the ones requiring local board release.

Action by the services came in response to a growing volume of complaints from industry that the Army and Navy recruiting tactics, coupled with official statements indicating that married men and fathers would soon be subject to induction, were stripping many plants of men who couldn't be replaced. The move has been widely accepted as a step toward ending all recruitment and supplying the full needs of all branches of the service through the draft machinery.

Pay for Women Workers

WLB has adopted a far-reaching policy of "equal pay for equal work" for women employes in war industries —a decision of interest to manufacturers at a time when they are beginning to experiment with female help in new jobs. The decision, unanimous, applied to a dispute involving 7600 employes of the Brown & Sharpe Manufacturing Co. of Providence, R. I.

Industrial Alcohol Advisory Committee

WPB announced the formation in September of an industrial alcohol producers industry advisory committee of which Dr. Walter G. Whitman, Assistant chief of the chemicals branch, is presiding government officer. Members, drawn both from the industrial alcohol and the distillery industries in harmony with the wartime conversion of the latter to war work, are: James McLaughlin, Carbide & Carbon Chemicals Corp.; Dr. Lewis H. Marks, Publicker Commercial Alcohol Co.; Glen Haskell, U. S. Industrial Chemicals, Inc.; Owsley Brown, Brown-Forman Distilling Co.; Julian P. VanWinkle, Stitzel Weller Distillery; I. Strouse, Baltimore Pure Dye Distilling Co.; H. F. Willkie, Joseph E. Seagram & Sons, Inc.; W. H. Venneman, Frankfort Distilleries, Inc.; J. B. Cella, Roma Wine Company, Inc.; Carl J. Kiefer, Schenley Distillers Corp.

POWERS TO REPLACE KUHN IN C.W.S. PROCUREMENT

COLONEL H. A. Kuhn, Commanding Officer of the New York Chemical Warfare Procurement District, with Headquarters at 292 Madison Avenue, New York, N. Y., has been assigned to duty in the Office of the Chief, Chemical Warfare Service, Washington, D. C. His position as Commanding Officer of the New York District will be assumed by Colonel Patrick F. Powers on October 1, 1942.

Colonel Kuhn has held this post as Commanding Officer for the past four years. Prior to that time, he spent two years as head of the Chicago Chemical Warfare Procurement District.

Before the war, his functions were concerned chiefly with laying plans for just such an emergency as has developed. In this connection, he worked closely with the chemical industry and is familiar with its facilities.

In the summer of 1940, when the defense program was inaugurated, heavy demands were placed on the Chemical Warfare Service and the New York Office embarked on a very large expansion which has increased the personnel from half a dozen employees to an organization which now runs well over a thousand.

ALIEN PROPERTY CUSTODIAN CONTROLS BUFFALO ELECTRO-CHEMICAL

BY SEIZING an additional 2,396 shares of Buffalo Electro-Chemical Co., Inc., Tonawanda, N. Y., on October 2, Leo T. Crowley, Alien Property Custodian, took stock control of that company, producer of 50 percent of the hydrogen peroxide in this country. A block of 3,691 German-owned shares was taken over by the Custodian on July 1. As a result of conferences being held between the Custodian and Mr. Charles A. Buerk, president, facilities of the plant in Tonawanda may be expanded in the near future.

GREAT BRITAIN INCREASES FACILITIES FOR PRODUCING RUBBER SUBSTITUTES AND RECLAIMED RUBBER

Special Correspondence

THE campaign for the establishment of a synthetic rubber industry in Great Britain still continues despite the Government's hitherto negative attitude, and it is not quite impossible that the advisory committee appointed to probe into the problems involved will join its voice to the chorus of supporters of a synthetic industry. The question is, to say the least, not yet shelved. In the meantime the Department of Scientific and Industrial Research has reported in favor of a new heat process for the reclamation of scrap rubber. Plant extensions have been undertaken by various rubber manufacturers for the application of the heat process, while the Government has lent its support to extensions for the use of the alkali process. Rubber substitutes are to be produced in greatly increased quantities. Polyvinyl chloride features prominently among these products. The necessity to curtail the consumption of rubber for civilian needs has already had far-reaching effects on the rubber manufacturing trades. It is now reported that the British Latex Manufacturers' Association which comprises thirty firms has formulated a voluntary concentration scheme. This announcement follows other "telescoping" measures in the rubber trade.

DEHYDRATION OF FOODS

The first English dehydration plant for vegetables has been erected in London where a well-known private firm working in cooperation with the Ministry of Food, will dehydrate carrots, cabbages and potatoes on a large scale. About 80 tons of potatoes are to be treated per week, with an expected yield of 9 tons. The potatoes are peeled first by a machine lined with carborundum. The tin packs of dried and compressed vegetables are filled with nitrogen to increase the lasting powers of the food. Dehydrated meat has been received in England from overseas, and a large order for dehydrated butter fat has been placed with New Zealand. Most of the dehydrated foods have met with a favorable reception by English housewives; this applies in particular to dehydrated eggs. Dehydrated meat was first tried out on the unsuspecting visitors of some English restaurants; these did not notice any difference as compared with the usual article.

ARTIFICIAL FIBERS

Characteristic of the growing interest in plastics is the news of the formation of a £300,000 ($1,200,000) company by one of the leading producers of artificial fibers in Great Britain. The Celanese Plastics Development Ltd. is to act as manufacturer, importer, exporter and dealer in plastics and synthetic resins as well as all kinds of chemical substances and products, drugs, paints, varnishes, enamels, coatings, colors and their transformation products and derivatives. The field of permitted activities has thus been drawn rather wide, but it may be assumed that Celanese will concern itself mainly with the production of plastics. Continental rayon producers are known to have spent much money on the production of full-synthetic fibers of the Nylon and Perlon type, and though no products of this type are yet known to be available in Continental European markets (apart from Nylon which is made in France as well as in Great Britain and the I. G. Farbenindustrie range of Igelit products) claims that great progress has been made have been put forward by several rayon and cell-wool producers.

PAINT DEVELOPMENTS

The paint industries, now engaged on a comprehensive scheme for the concentration of production in a limited number of factories, have been compelled to make considerable alterations as a result of new and more severe restrictions on the use of raw materials. Since lead is in short supply, the use of red and white lead is limited even for such an essential purpose as for priming on steel sheet. Lithopone is no longer released for the manufacture of factory white, and paint manufacturers have been warned that the supplies of barytes may become rather less plentiful than of late. Alternative extenders have therefore been suggested by the Miscellaneous Chemicals Control. Wool grease has been used on a large scale for camouflage paints, but in future, users of the material must make monthly applications stating their requirements to the leading seller. Paint standards which have been prepared for British users are performance standards. It is pointed out that flexible arrangements are desirable in view of the possibility of changes in the supply position.

Four types of paints are generally used for camouflaging—flat oil paints, oil-bound water paints, bituminous emulsion paints, and wool grease emulsion paints. For brickwork and clay tiles all these materials may be used, though on extremely absorbent surfaces addition of 25 percent of boiled oil to flat oil paint is recommended. For iron and steel the materials mentioned are used in conjunction with a priming consisting of dark colored red lead or white lead/red lead mixture. Galvanized iron and steel requires no primer, but must be degreased if new and prepared by special treatment, e.g., with a mordant, before the camouflage paint is applied. Glass and smooth slate is camouflaged by a flat oil paint. Wood is normally primed with a suitably tinted white lead/red

PROGRAM
NATIONAL INDUSTRIAL CHEMICAL CONFERENCE

WEDNESDAY AFTERNOON
November 25, 1942, 2:00 - 4:00 pm

"Plastics and Paper"
Presiding, NORMAN L. SHEPARD
Chemical Director, American Cyanamid Company
New York, New York

"Raw Material Supplies for Plastics Manufacture"
By ARTHUR E. PETERSEN
Chief of Organic Plastics and Resins Section, Materials Division, Chemical Branch, War Production Board, Washington, D. C.

"Paper and Paper Materials"
By ALLEN ABRAMS
Vice-President in Charge of Research and Development, Marathon Paper Mills Company
Rothschild, Wisconsin

THURSDAY EVENING
November 26, 1942, 6:30 pm

Joint meeting of the National Industrial Chemical Conference and the Chicago Section of the American Chemical Society.

Presiding, R. C. NEWTON
Vice-President, Swift & Company, Chicago, Illinois

"The Electron Microscope in Relation to Chemical Research"
By V. K. ZWORYKIN
Associate Director, Research Laboratories
RCA Manufacturing Company
Camden, New Jersey

FRIDAY AFTERNOON
November 27, 1942, 2:00 - 5:00 pm

"Food and the Relation of Food to the Chemistry of Plants and the Soil"
Presiding, C. G. KING, Scientific Director
The Nutrition Foundation, Inc.
New York, New York

"The Soil and Crop Basis of Better Nutrition"
By L. A. MAYNARD
Director, School of Nutrition and the United States Plant Soil and Nutrition Laboratory, Cornell University, Ithaca, New York

"Soil Fertility and the Human Species"
By W. A. ALBRECHT
Chairman Department of Soils,
College of Agriculture, Columbia, Missouri

"Food and Nutrition as Related to War"
By C. G. KING, Scientific Director
The Nutrition Foundation, Inc.
New York, New York

FRIDAY EVENING
November 27, 1942, 8:00 - 9:15 pm

Presiding, VICTOR CONQUEST
Director of Research, Armour & Company
Chicago, Illinois

"The Cyclotron and Its Uses in Research"
By P. GERALD KRUGER
Department of Physics, University of Illinois
Urbana, Illinois

SATURDAY AFTERNOON
November 28, 1942, 1:45 - 5:00 pm

"A Symposium on Industrial War Problems"
Presiding, C. S. MINER,
Director, Miner Laboratories, Chicago, Illinois

"Control of War Time Incendiaries"
By WARD V. EVANS
Professor of Chemistry, Northwestern University
Evanston, Illinois

"Waste Treatment in Industry as Related to War Economy"
By F. W. MOHLMAN
Director of Laboratories,
Sanitary District of Chicago, Chicago, Illinois

"The Salvage and Conservation of Chemicals in Industry"
By S. DONALD PERLMAN
Executive Chemical Director, Industrial Salvage Section, Conservation Division, War Production Board

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- Protective Coatings
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- Lime and Gypsum
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lead mixture and painted with a flat oil paint. For asbestos-cement, concrete, cement and cement bricks various primers may be used together with oil bound water paint or bituminous or wool grease emulsion paint. For asphalt, bituminous roofing felt, hessian, and bitumen one coat of bituminous emulsion paint is used, but great care must be taken to avoid "bleeding" and discolorization. Besides, cracks may develop if unsuitable types of paint are used.

War building has opened a new outlet for certain other chemical products. To prevent mold growth in houses damaged by bombs and fire, antiseptic washes are recommended. These may consist of a 1 percent solution of sodium pentachlorphenate (1 lb. to 10 Imperial gallons of water) or a 1 percent solution of the sodium salt of salicyl anilide. In wartime, supplies of these materials will naturally be restricted, and if not available a solution of zinc-silico-fluoride (6 oz. to the gallon) is recommended by the Building Research Station.

To save timber which is in short supply, it is intended to erect a number of all-concrete cooling towers at power stations. Full-scale tests have proved the possibility of satisfactory construction with interlocking reinforced concrete slats. These are precast and assembled in table sections like grids. Problems of weight and shape—to present the maximum cooling surfaces—are said to have been overcome so that, subject to careful erection, satisfactory operation at reasonable construction cost should be possible. The development is typical of much work which is now going on in chemical industries where large engineering parts are required.

CELLULOSE INDUSTRIES

Esparto paper mills have changed over to straw as a wartime raw material, and if experience during the past year counts for anything, not all of them will return to esparto after the war. Straw is the only raw material grown in sufficient quantities in England to warrant large-scale conversion into pulp. A suitable organization has been set up to insure regular supplies, and it is thought that a straw paper industry could serve permanently as a link between agriculture and the cellulose industry. In normal circumstances the English paper mills found that they could produce the chemicals which they required more cheaply than they could be supplied by chemical firms, largely because of the high cost of transport and preparation of transport for such products as chlorine and sodium compounds.

Cellulose-fiber laminations impregnated with resin adhesives are now used extensively in the aircraft industry for complicated components which can be built up in layers on wooden molds without expensive tools and long preparations. Drying and sanding are the only finishing requirements to produce a smooth surface. At first unstressed and lightly-stressed parts only

were made from laminated and impregnated cellulose fibers, but now the material is being used also for wing tips and other aircraft parts subject to considerable strain. Virtual absence of corrosion and electrical conductivity are generally advantages, but where electrical properties are desired the laminated products can be easily metallized. Heat resistance was found to be satisfactory up to 200° C.

IRISH TANNING

In a recent review of the work of the Eiré Emergency Scientific Research Bureau reference was made to the benefits which the Irish tanning industry derived from experiments with processes for the production of sulphonated oil and sodium sulphide from indigenous materials. A process has been developed for the production of phosphoric acid, and the Bureau is working also on the manufacture of citric, lactic and mucic acids.

Spent oxide from gasworks has been investigated as a source of sulphur for the production of sulphur dioxide and sulphuric acid. Other work relates to the manufacture of aluminum sulphate, the replacing of medicinal glucose by invert sugar solution, the production of zinc oxide (which is already made on a commercial scale) and the development of formulas for the preparation of creosote disinfectants, axle grease, and fatty acids required in the rubber trade. The Bureau is now working on a carbon black material and certain essential pharmaceutical products.

COLONIAL DEVELOPMENTS

The loss of Malaya and the Dutch East Indies has increased interest in the possibilities of producing Eastern commodities in African and other Colonial territories. A processing plant for tung nuts exists at Cholo (Nyasaland), and though the plantations in that country are only now entering the fruit-bearing stage, an appreciable contribution to Allied supplies of tung oil may be expected from the 5,000 acres planted in the Colony. Hevea and other rubber-yielding plants are growing in Ceylon, and larger supplies can be obtained from that source, though increased production would be more or less injurious to the trees.

Production of power alcohol has increased in several Colonies since imports of petroleum products are meeting with difficulties; Mauritius is among the Colonies where production has recently started. Quinine is to be produced in several Colonies, but not in the West Indies. Experiments with soybeans in West Africa have given promising results, and it is hoped to develop an export trade. The production of salt is being increased in several West Indian islands including the Bahamas and the Turks Islands, and a fertilizer plant is to be erected soon in the Bahamas. These isolated examples of Colonial progress show the extent to which the tropical and sub-tropical countries can contribute to the war effort.

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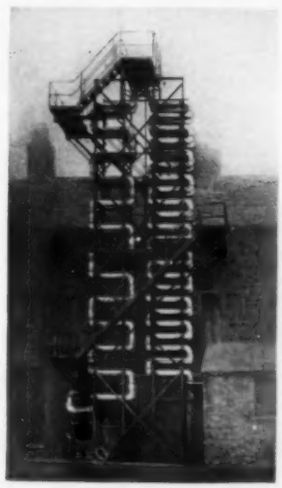

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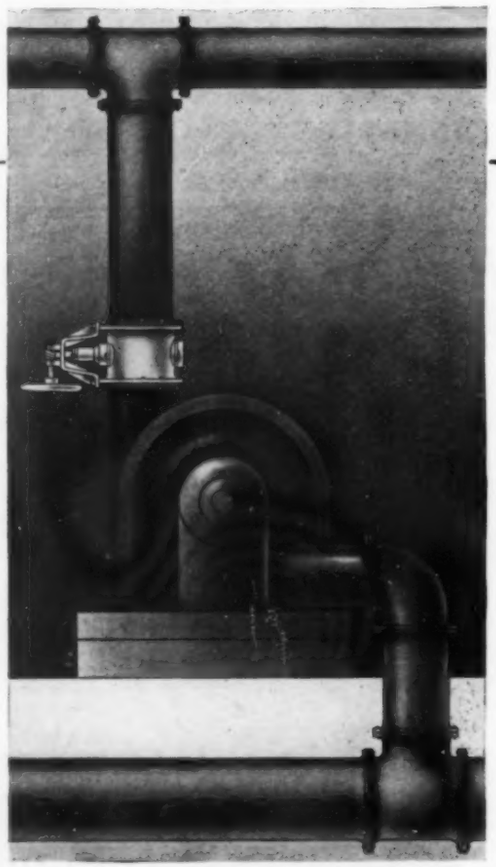

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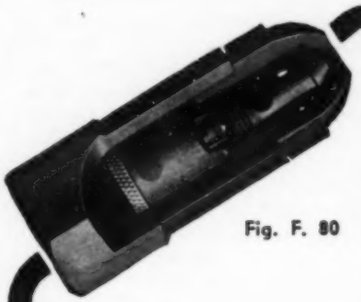

Fig. F. 80

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NAZI CHEMICAL INDUSTRY UNDERGOES CHANGES CAUSED BY RAW MATERIAL SHORTAGES

Special Correspondence

EDITOR'S NOTE: *Cut off from direct correspondence with all except a few foreign sources in neutral countries, these notes interpret recent developments in continental Europe as reported in publications and official documents received in the United States. These monthly letters, prepared in this country, will be continued only so long as pertinent material of interest to American chemical industry is available for our comment and interpretation.*

COAL, precious as a fuel and as a chemical raw material, is not going to be too plentiful in the Reich this winter despite Germany's continental monopoly. This will be partly due to shortage of transportation facilities, to reduced output per shift, and to the lack of skilled miners. To be sure, the incorporation of Czech and Polish as well as western European coal producing areas increased the supply available to Germany. This has been partly counterbalanced, however, by Germany's having to supply Scandinavian and other European countries with coal which formerly came from England and elsewhere.

Not all the coal mined in Germany is suitable for use in coke ovens, gas works and blast furnaces. Western German coal is most satisfactory for coking, but the central and eastern regions are deficient in good coking coal. This means an additional hauling problem and is responsible for the fact that the size of blast furnaces in Upper Silesia has to be considerably smaller than those of the Ruhr, since only small charges can be put into the furnaces with less suitable coke.

Extensive experiments have been carried on for some time in Germany to extend coking coals of poorer grade by mixing small amounts of good coking coal. Experimental coking of such mixtures is reported in *Brennstoff Chemie*. It is stated that by proper grinding and blending, it is possible to produce a high grade metallurgical coke by blending only small amounts of good coal with non- and poorly-coking coals or with coke breeze.

COAL FOR CHEMICALS

The chemical industry is a large coal consumer. Aside from using coal as fuel and as a source of electric power for increased production of light metals and synthetics (four fifths of Germany's power is thermal due to lack of good natural water power except in areas toward the Alps) coal is also being used in growing amounts as a chemical raw material. It is estimated that from 5 to 10 percent of the German coal production is now being used by the chemical industry. Among the largest consumers is the synthetic motor fuel industry. Before the outbreak of the war, Dr. Pier, I. G. Farben's coal expert, reported that in order to produce one metric ton of synthetic gasoline it required 1.66 metric tons of dry coal substance from lignite or 3.5 tons of bituminous coal. At that time he stated that to produce 5 million tons of synthetic gasoline it would require 20,000 workers to mine the coal and 30,000 workers to maintain and operate the synthetic gasoline plants.

In 1937, 23 German low-temperature carbonization plants processed 12,381,000 tons of brown coal as against 2,794,000 tons in 1929. In these plants 643,000 tons of tar and 3,021,000 tons of coke were produced, with much of the tar being processed further into motor fuels. 29.7 percent of the Reich's bituminous coal output was made into coke, tar, benzol, ammonia, sulphur, and by-products. In 1937 in German bituminous coking plants 40,921,000 tons of coke were produced, 1,592,000 tons of tar, 529,000 tons of benzol, 536,000 tons of ammonium sulphate, with smaller amounts of naphthalene, sulphur, and phenol. In 1936, German production of phenol was estimated at around 20,000 metric tons.

PHENOL RECOVERY

Liquors of carbonization and hydrogenation plants are being used increasingly for the recovery of phenol. A considerable advance in phenol recovery is claimed in a process developed since 1937 by the Lurgi Gesellschaft für Wärmetechnik. In 1940, I. G. Farben, also working on the same problem, pooled its research activities with the Lurgi company, and after 18 months' testing on a pilot plant scale began full scale operations in October of last year. A solvent named "Phenolsolvan," a mixture of esters of various higher alcohols with a specific gravity around 0.88 and a boiling range of 110 to 130 deg. C., is used. It is claimed to improve efficiency especially in extracting phenol from lignite low-temperature carbonization liquors, and is stated to have a low operating cost.

With an increasing output of liquefiable petroleum gases resulting from the expansion of the Fischer-Tropsch synthesis (it is estimated that 10 percent of the total output of Fischer-Tropsch plants is in the form of hydrocarbon gases) a new organization has been set up to secure a better distributing system and more efficient utilization of containers in view of the shortage of steel cylinders. Members of the former propane syndicate have now formed the Propan G.m.b.H., which will take over the sale and distribution of propane, butane, propylene, butylene, isobutane, and isobutylene.

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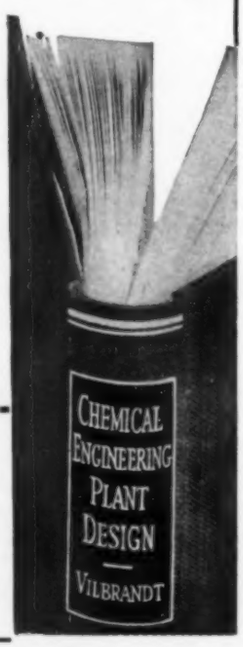

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tries, is no longer being used in as large quantities as formerly for binding brickets. Sulphite waste liquors and artificial resins are being used where possible either alone or in admixture with coal tar as a binding substance. In 1938 some 63 percent of the total German lignite production, or 44,000,000 tons, and 3.4 percent of the total bituminous production, or 6,897,000 tons, was pressed into brickets. This represented a considerable increase over previous years and was due not only to large household consumption but to increasing amounts of brickets used for low temperature carbonization.

A few years before the outbreak of the war, coal-tar pitch was also being used increasingly in the manufacture of a new composition known as "Teplamasse." It claims to combine the water resistance of coal tar with mechanical properties of asphalt and was used as a substitute for petroleum asphalt for coating, rust-proofing, and insulating steel pipes, building foundations, etc. The coal-tar pitch is filled with stone dust or micro asbestos according to the purpose for which the composition is to be used.

Pitch coke is being used along with carbon precipitated on the walls of coke oven and gas furnace chambers to make carbon electrodes. The need for carbon electrodes in Germany has shot up tremendously in recent years with the aluminum, magnesium, carbide, and metallurgical developments. The pitch coke used for electrodes may contain 0.7 percent volatile matter, 0.9 percent ash, and 0.7 percent sulphur. The ash content may be reduced if the heavy oil fraction obtained by distillation is added to the coal-tar pitch before carbonization.

RUBBER WASTES

Experiments are described in *Brennstoff Chemie* to obtain motor fuels and fuel oil from rubber waste. Low temperature distillation of rubber waste at 500 to 750 deg. C. in a large laboratory plant yielded 46 percent coke, 35 percent tar, 7 percent liquor, and 12 percent gas and losses in weight. The coke is not suitable for active carbon or fuel, owing to its high ash content and low heat of wetting. On distillation, however, the tar yielded 16 percent benzene, 50.7 percent diesel oil, and 32.3 percent by weight residual oil. The benzene fraction consists mainly of aromatic hydrocarbons and is stated to have a high knock resistance, but its high sulphur content and relatively poor ignitability, the diesel oil fraction has to be blended with synthetic or petroleum fuels. The process seems of only theoretical interest in view of the low fuel yield and of the small amount of rubber waste available. Reclaiming of rubber scrap for both vulcanized natural and synthetic rubber is stated to be improved in a new German patent. The scrap is dumped into a tank containing a solvent and is heated from 10 to 20 hours at 100 to 300 deg. C. Air or oxygen is bubbled through the mixture, to which a nitrogen compound is also added.

Peat is being used increasingly as a fuel in rural areas of Denmark because of the shortage of coal. After burning, the peat ash remaining is being used as a fertilizer. Although the handling of the ashes causes some difficulty, and the phosphoric and potassic materials vary considerably, it also contains lime, which is said to be needed on many of the Danish soils.

FERTILIZER SITUATION

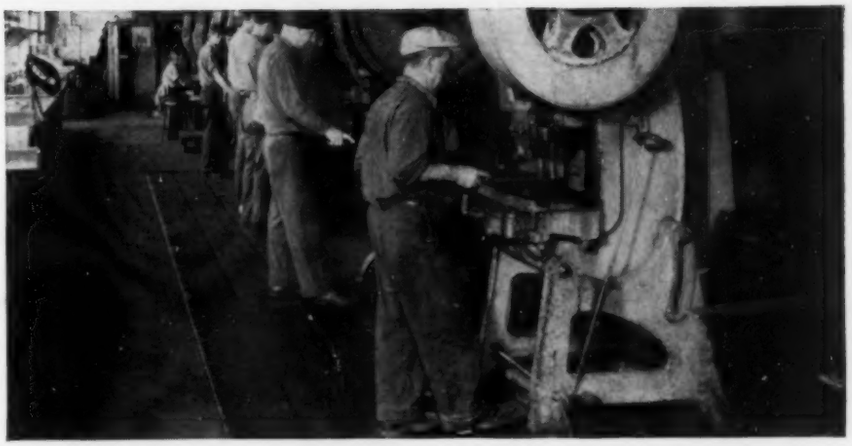
Potash and nitrogen fertilizers are relatively plentiful in continental Europe due to large German and Alsatian potash production, and the large capacities for synthetic nitrogen manufacture in central European countries. The supply of phosphatic fertilizers, however, is especially short. This is due to the lack of phosphate rock, to the tight situation in sulphuric acid needed for the production of superphosphates, and to lack of transportation facilities.

In pre-war years, Germany used approximately 19 kilograms phosphoric fertilizers per hectare, while in Balkan countries such as Rumania, only 1/15th of a kilogram per hectare was used. This fact, along with the meager application of other fertilizer materials, is claimed to be largely responsible for the low agricultural yields of Rumania, which are on the average only half those of the Reich. Soils in western Europe, however, are especially in need of phosphates if agricultural yields are to be kept up, especially of such products as sugar beets. Germany used to import more than a million tons of rock phosphates a year, chiefly from the United States, Soviet Russia, and North Africa, and also 400,000 tons a year of basic slag, or Thomas meal, from western European countries, especially Belgium. Only a fraction of these imports is now available. In 1941 Italy received 407,000 tons and Germany 94,000 tons of phosphate from Tunisia, which is currently reported to be shipping phosphates at a rate of 60,000 tons per month to these two countries.

The phosphate situation is less acute in western Germany where basic slag from increased iron production is available. Several superphosphate plants in the eastern part of Germany are reported to have closed down in the spring of this year for lack of raw materials. Scandinavian countries are having a hard time getting phosphatic fertilizers, and Sweden has substituted domestic apatite for raw phosphate which it is no longer able to import.

MERCURY FOR FULMINATE

Italy is reported to be sending a large share of its mercury output to Germany to be manufactured into fulminate and other mercury compounds needed for the manufacture of explosives. Stabilimento Minerario di Sieli, the second largest producer of mercury in Italy is reported to have reached a record output of 1,500 tons in 1941, which exceeds half the Italian mercury production as reported for the last year before the war.



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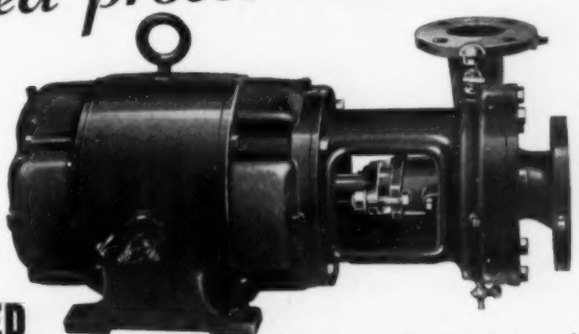

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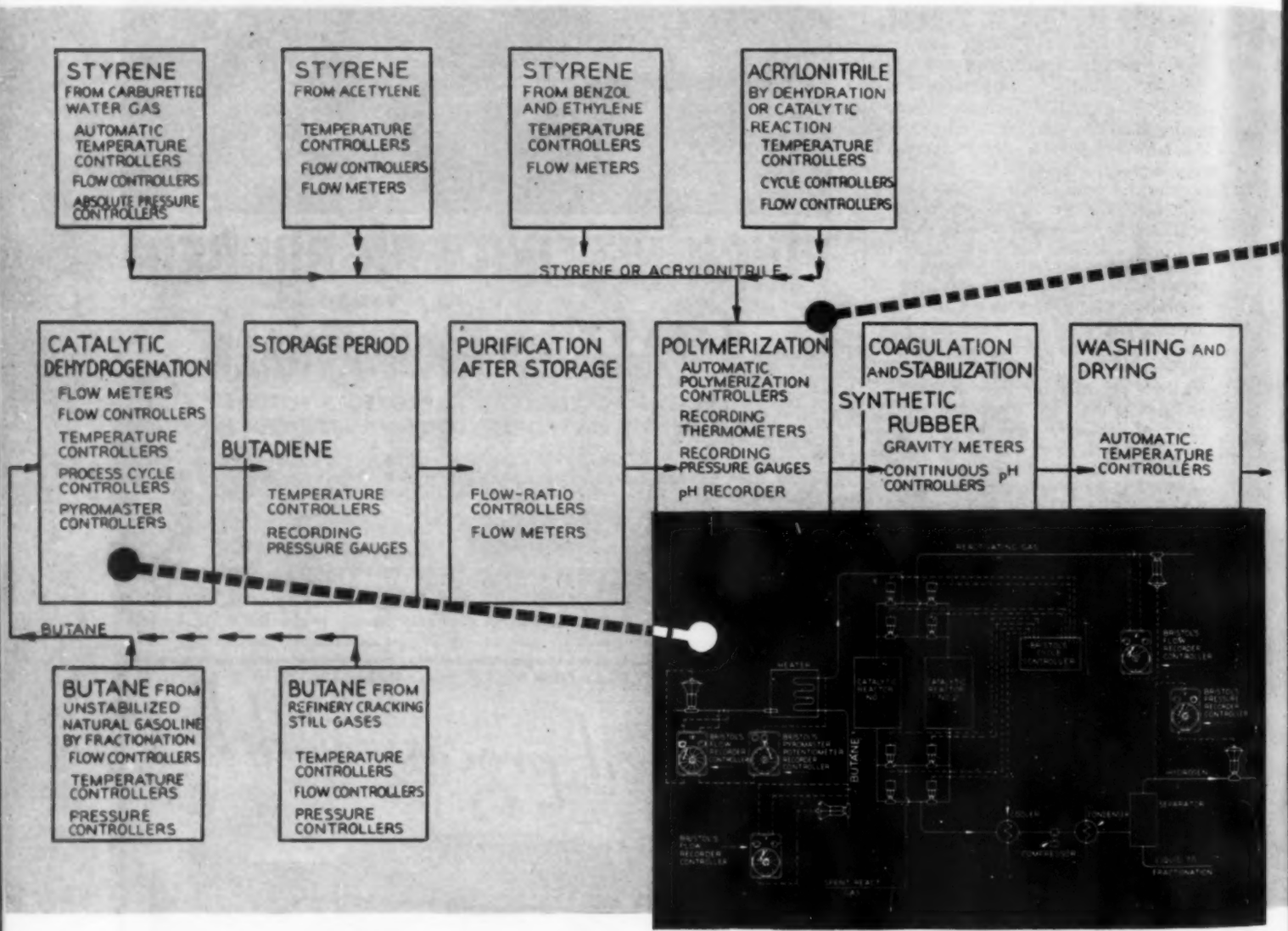

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PERSONALITIES

James A. Wilson

R. E. Wilson

✦ JAMES A. WILSON has been promoted to the position of assistant plant manager of the Trenton, Mich., plant of Monsanto Chemical Co., according to a recent announcement by Felix N. Williams, Phosphate Division production manager. Mr. Wilson was formerly superintendent of the company's Carondelet, Mo., plant. In his new post he will work under Edward A. O'Neal, Jr., plant manager. After doing summer work for Swann Chemical Co. in 1928 and 1929, Mr. Wilson returned to Swann upon completion of a post-graduate course at Massachusetts Institute of Technology in 1931. He was in the research department of Swann when that company was absorbed by Monsanto and was later transferred to operations. In 1939 he went to Carondelet as superintendent.

✦ EDWIN P. JONES is now associated with the Engineering and Development Section of the Eastern Regional Research Laboratory, of the Department of Agriculture at Philadelphia, Pa. Mr. Jones is in the capacity of principal research chemist working on one of the raw material problems connected with the war effort. He had for some years been in the pulp and paper industry.

✦ CHARLES W. RIPPIE, formerly petroleum technologist for the Solvay Sales Corp., has joined the Petroleum Chemicals Department of the Organic Chemicals Division of Monsanto Chemical Co., St. Louis, where he will handle technical sales work. Dr. Rippie has a background in the petroleum field having served in research, manufacturing and sales capacities with the Shell Oil Co. and Cities Service Oil Co. before going to Solvay. He received his bachelor's degree in chemistry from the University of Michigan in 1919; continuing later with graduate work in chemistry at the University of Illinois. He received his doctor's degree from that school in 1926.

✦ ROBERT E. WILSON has been selected to receive the Perkin Medal of the Society of Chemical Industry for 1943. This medal is awarded annually for outstanding work in applied chemistry and the medalist is selected by a committee representing the five chemical societies in the United States.

In January, 1935, Dr. Wilson became vice chairman of Pan American Petroleum & Transport Co. Since February, 1937, he has been president of Pan American Petroleum & Transport Co., American Oil Co., and other subsidiaries. He has served as chief petroleum consultant to the Advisory Commission of the Council of National Defense, and its successor, OPM.; a member of the Petroleum Industry War Council and chairman of the Council's Committee on Petroleum Economics. In March, 1942, at the request of the United States Treasury Department, he became one of four managing directors of the General Aniline and Film Corp. recently taken over from German ownership.

✦ E. A. METCALF has been appointed manager of Neodesha, Kans., refinery of the Standard Oil Co. of Indiana. Mr. Metcalf began work at the refinery when it was part of the Standard Oil Co. (Kansas). When the Kansas company sold the property to Standard of Indiana, he was continued as superintendent, in which position he remained until April, 1942, when he became acting manager.

✦ HAROLD R. SNOW, who was formerly manager of the Neodesha unit, of the Standard Oil Co. of Indiana, accepted a position as assistant general superintendent of Pan American Refining Co.'s refinery at Texas City, Tex., after several months of special work on a butadiene project. Mr. Metcalf has been succeeded by H. G. Schnetzler as superintendent at Neodesha and at the same time continues as chief chemist. Mr. Schnetzler began his career with Standard of Indiana in 1924 as a chemist. In 1932 he was transferred to Neodesha, in May, 1938, he was made chief chemist and on April 20, 1942, he became acting superintendent also.

✦ JOHN SLEZAK head of the tank branch of the Chicago Ordnance District and now acting chief of the industrial division, has been promoted to the rank of lieutenant colonel. Col. Slezak is on leave of absence from his position as president of the Turner Brass Works, Sycamore, Ill.

✦ SAMUEL C. HARRIS, director of sales of the du Pont company's Electrochemicals Department, completed 25 years of service on September 15 and was honored at a luncheon given by his associates at the du Pont Hotel in Wilmington. Mr. Harris started as a timekeeper in the engineering department of the du Pont company in 1917, following his graduation from Davidson College. He served in the first World War and returned to work in the personnel division and the purchasing department of the company until 1922. He became southern sales representative of the Roessler & Hasslacher Chemical Co. in 1922 and in January 1926 was made manager of their Philadelphia office. The Roessler & Hasslacher Chemical Co. was merged with du Pont in 1930 and in 1936 Mr. Harris was made assistant director of sales of the R. & H. Chemicals Department, now the Electrochemicals Department.

✦ A. C. OTTOSON is leaving the University of Illinois in order to accept a position with the Imperial Glass Corp.

✦ HILAND G. BATCHELLER, president of the Allegheny-Ludlum Steel Corp. of Pittsburgh, has been appointed head of the W.P.B. Iron and Steel Branch, it has recently been announced by Chairman Donald M. Nelson of the War Production Board.

✦ RUPERT A. CHAFFEE, for four years engaged in engineering work for Clark Bros. Co., Olean, N. Y., resigned his position in July to enter military service, and has been assigned to the academic department of the Army Air Corps Technical Training Command at Sheppard Field, Wichita Falls, Tex., with the rank of second lieutenant.

✦ JOHN H. MERRIAM, chemical engineer, formerly with Sherwin-Williams, is to be the superintendent of the new potassium chlorate plant of International Minerals and Chemical Corp., shortly to be in operation at Cincinnati, Ohio.

✦ H. G. HYMER, who for the past five years has been associated with the Gen-

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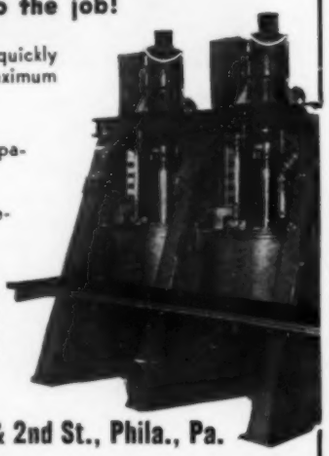

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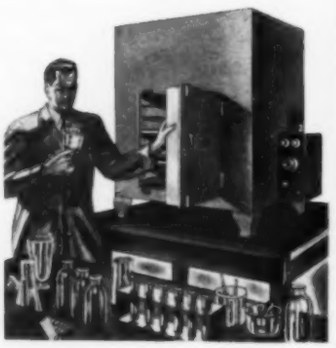

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DESPATCH OVEN COMPANY
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eral Chemical Co. in New York as development and mining engineer, has left that concern to take a position as senior evaluation engineer with the Reconstruction Finance Corp. in Washington. Mr. Hymer, a fluorspar expert, has done considerable engineering development work in New Mexico, Arizona, Colorado and California, for General Chemical Co.

✦ D. L. IMMEL has been promoted to assistant plant superintendent at the Copperweld Steel Co.'s Warren, Ohio, plant.

H. D. Grant

✦ HOWARD D. GRANT has been elected president and Stevens H. Hammond executive vice president of Whiting Corp., Harvey, Ill. Mr. Hammond will also serve as chief of the executive staff. He is the son of Gen. Thomas S. Hammond (formerly president of the Whiting Corp.), now in charge of the Chicago district ordnance staff. Mr. Stevens Hammond will devote full time to matters of policy and management, giving particular attention to production and material procurement in Whiting's effort to reach maximum war output. Serving with him on the executive staff will be D. Polderman, Jr., formerly in charge of the New York district office, who will specialize on sales and customer service, and H. D. Grant, president.

✦ MERLE L. GRIFFIN has resigned his position with the Chemical Branch of the War Production Board in order to return to the Shell Oil Co. His work with Shell will consist principally of liaison activities on behalf of the Shell Development and Shell Chemical Companies with various governmental agencies and private industry in the east and middlewest. He will be located in Washington, D. C.

✦ R. L. CAIN, who for the past year served as a priority specialist for Westvaco Chlorine Products Corp., has joined the General Sales Department of the Pennsylvania Salt Manufacturing Co., Philadelphia, in the Heavy

Chemicals Division. He was previously in charge of sales and service for Westvaco in New York City and at the same time served as divisional sales manager of the Crutin-Howe Corp., Westvaco affiliate.

✦ BENJAMIN F. SHEPHERD, chief metallurgist for Ingersoll-Rand Co. and a past-president of the American Society for Metals, was awarded the Albert Sauveur Achievement Award during the course of the recent exposition in Cleveland.

✦ BENNETT PREBLE, process engineer in the Magnesium Division of International Minerals and Chemical Corp., was formerly with the California Spray Chemical Co., Richmond, Calif. He is a graduate of the California Institute of Technology in chemical engineering.

✦ A. E. RUEHLE, is chief chemist of the Magnesium Division of International Minerals and Chemical Corp., at Austin, Tex. He was educated at the University of Idaho, Columbia University, Massachusetts Institute of Technology, and was formerly with the Bell Telephone Laboratories of New York City.

Loren V. Forman

✦ LOREN V. FORMAN has been appointed research associate on the staff of the Institute of Paper Chemistry, Appleton, Wis. Dr. Forman will be instructor in pulp and paper technology and in charge of pulp and paper testing. He is a native of Iowa and received his under-graduate training at Iowa State College, graduating from the chemical engineering department in 1934. He is an alumnus of the Institute, receiving his M.S. degree in 1936 and his Ph.D. degree in 1940. Since 1940 Dr. Forman has been associated with the Mead Corp., dividing his time between Chillicothe, Ohio, and the Kingsport, Tenn., mills.

✦ C. K. TURNER is superintendent of the electrolytic plant of the Magnesium Division of International Minerals and Chemical Corp., at Austin, Tex. He is a chemical engineering graduate

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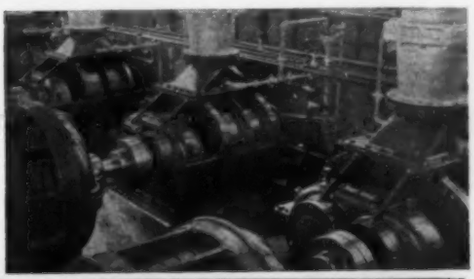

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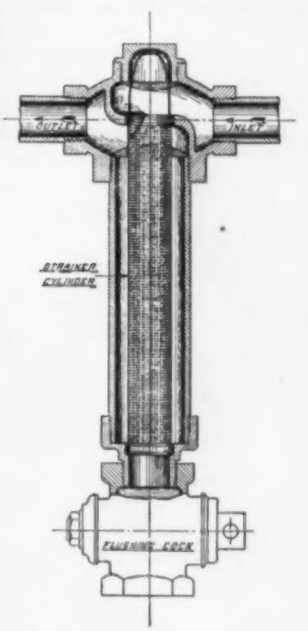

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from Case School of Applied Science and was formerly on production work with the American Steel & Wire Co., Cleveland, Ohio.

✦ NELSON C. WHITE is superintendent of the magnesium chloride plant at Austin, Tex., of the International Minerals and Chemical Corp. Mr. White was formerly production manager of Fields Point Mfg. Corp., Providence, R. I. He is a chemical engineering graduate from Rhode Island State College.

Eugene M. Hetzel

✦ EUGENE M. HETZEL of the Carondelet, Mo., plant of Monsanto Chemical Co. has been promoted to superintendent, succeeding Mr. James A. Wilson. A graduate of the University of Wisconsin. Mr. Hetzel joined Monsanto at Anniston, Ala., in 1936 as research chemist. He continued in that capacity until his transfer to the Carondelet plant in March, 1942.

✦ EDGAR WREGE, is a chemical engineer attached to the Magnesium Division at Austin, Tex., of the International Minerals and Chemical Corp. Prior to joining this organization he was taking graduate work in chemical engineering at Columbia University and at the same time teaching at Hofstra College.

✦ GILBERT L. COX of Westfield, N. J., and formerly connected with the International Nickel Co. of New York as a research and development engineer, has recently been promoted to the rank of lieutenant colonel. He joined the Watertown Arsenal organization in March, 1941, as a major in the laboratory. Colonel Cox was born in Calverton, Va., educated at the local high school, won a B.S. degree at Virginia Polytechnic Institute in 1928 and did postgraduate work at Massachusetts Institute of Technology securing a M.S. in 1930 from that institution.

✦ ALBERT K. ACKOFF, chemical engineer formerly associated with Westvaco Chlorine Products Corp., has recently joined the Industrial Development Division of Eastman Kodak Co., Rochester, N. Y. Mr. Ackoff obtained

his engineering degree from the University of Pennsylvania and his master's degree in chemical engineering from Massachusetts Institute of Technology. He had been active in the Junior Chemical Engineers of New York and was recently elected secretary-treasurer of that organization.

✦E. W. RITTER, recently appointed as assistant to G. W. Cole, president of the Corning Glass Works, has been called to Washington for work in connection with the U. S. Signal Corps. Mr. Ritter, who before joining the Corning organization was vice president of R.C.A., has had extensive experience in engineering, manufacturing and research, related to communication problems.

✦R. A. DIEHM has been appointed technical director of Container Corp. Dr. Diehm comes to Container Corp., from Rohm & Haas Co. of Philadelphia, where he devoted his time to research problems from 1929 to 1937 and to sales problems of a technical nature until July of this year. He received his B.S. degree in chemistry and physics from Purdue University in 1926, M.S. in microbiology from Rutgers in 1928, and Ph.D. from the same school in 1930.

✦C. V. HUMPHREYS, refinery engineer for Abasand Oils Ltd. since last March, has been appointed assistant general manager, according to an announcement of Max W. Ball, president and managing director. Mr. Humphreys started his refining experience with Standard of Indiana immediately on leaving college and later joined Imperial Oil Ltd. holding successively the position of assistant superintendent of the Ioco Plant, superintendent of the refinery and cracking departments at Sarnia, an assistant general superintendent of the Halifax plant. He left Imperial to joint the staff of M. W. Kellogg & Co. and from 1932 until March, 1942, he was in consulting practice in Winnipeg.

✦HERMAN E. BAKKEN, who has been an assistant director of research in the aluminum research laboratory of the Aluminum Co. of America, New Kensington, Pa., becomes associate director of the organization. E. H. Dix, Jr., chief metallurgist, and R. L. Templin, chief engineer of tests of the Aluminum Co., have been made assistant directors of the laboratory. Mr. Bakken is a native of Minnesota and attended the university in that State. He entered the employ of the Aluminum Co.'s research bureau in 1919. A year later he was placed in charge of research and development of the American Magnesium Corp.'s plant in Niagara Falls, of which he was made superintendent in 1926. Two years later he was appointed assistant director of research and transferred to New Kensington. Mr. Dix was born in Baltimore and is a graduate of Cornell, class of

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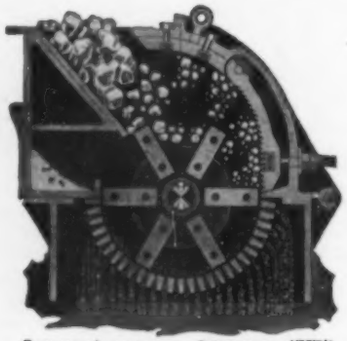

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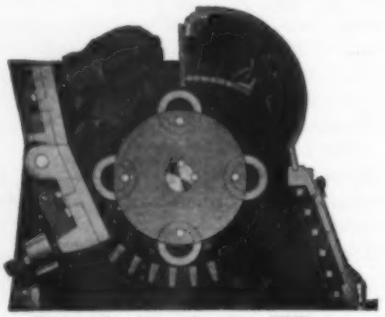
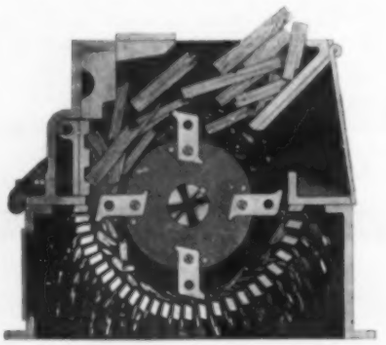


Sectional view showing Williams Ring type Coal Crusher for making stoker coal, domestic sizes, etc.



Sectional view of Williams "No-Nife" Hog type Shredder used for wood refuse, tan bark, chips, etc.

There are standard Williams machines for the reduction of practically every material, whether animal, mineral or vegetable—capacities range from 50 pounds to 300 tons per hour, permitting selection of exactly the proper size for your work. Whether you wish to grind chemicals to 400 mesh, crush 4 feet cubes of rock or shred steel turnings, you can profit by Williams' experience.

The Williams Patent Crusher & Pulverizer Co.
2706 North Ninth St. St. Louis, Mo.

Sales Agencies Include

Chicago, 37 W. Van Buren St. — New York, 15 Park Row — Oakland, Calif., 1629 Telegraph Ave.

Williams — BUILDERS OF HAMMERMILLS IN THE WORLD
PATENT CRUSHERS GRINDERS SHREDDERS

1914. He was employed by a number of industrial concerns in the East in the six years following his graduation. In 1920 he became chief of the metals branch of the engineering division of the Air Corps, Dayton, Ohio. He has been with the Aluminum Research Laboratories since 1923, and was appointed chief metallurgist in 1930. Mr. Templin was graduated from the University of Kansas in 1915, and was employed by the National Bureau of Standards for several years. He joined the Aluminum Company in 1919.

H. E. Bakken

✦ C. M. SUTER, chairman of Chemistry Department and associate professor of organic chemistry at Northwestern University, has been made director of chemical research for Winthrop Chemical Co., New York, N. Y. He severed his connection with Northwestern in September.

✦ E. G. BAILEY, vice president of Babcock & Wilcox Co., was presented with the first Percy Nicholls Award for notable scientific or industrial achievement in the field of solid fuels, by A.I.M.E.

✦ RICHARD BRIGHT is now on the staff of North Carolina State College.

OBITUARIES

✦ J. E. LOCKWOOD, naval stores consultant of Savannah, Ga., died October 3 after a brief illness. His age was 81. He resigned his position in the naval stores department of Hercules Powder Co. 11 years ago.

✦ JAMES M. DORN, who retired as head of Distilled Spirits Institute in 1938, died in a Washington, D. C., hospital September 8 after a prolonged illness. Dr. Born was 57 years old.

He was appointed commissioner of prohibition in 1927, and commissioner of industrial alcohol in the Treasury Department in July, 1930. He held this post for three years. In 1933, he was named head of the Distilled Spirits Institute, a post he held until 1938 when he asked to be relieved as acting executive head. Dr. Dorn remained, however, as technical adviser.

✦ HARRY V. WALLACE, vice president and director of sales of the Kimble Glass Co., died at his home in Vineland, N. J., during the night of September 15. Mr. Wallace was born June 28, 1894, in Sulphur Well, Ky., but spent his boyhood in Wenatchee, Wash. After experience in the sales field with the Socony-Vacuum Co. and the Owens-Illinois Glass Co., Mr. Wallace joined the Kimble Glass organization in October, 1931, as Chicago branch manager. In January, 1939, he was transferred to the main office of the company in Vineland and in June of the same year he became vice president and director of sales.

✦ CARL NELSON HAND, chemical engineer and retired plant manager of the Rubber Service Department of Monsanto Chemical Co., died September 18 at Charleston, W. Va., while en route from Ohio to his home in Miami, Fla. He was 50 years old. Mr. Hand with E. J. Smail, Jr., and C. O. North founded the Rubber Service Laboratories of Akron, Ohio, in 1922 and was president and general manager until 1929 when Rubber Service became a part of Monsanto Chemical Co. He continued as manager of the Rubber Service Department plant at Nitro, W. Va., until his retirement in 1938. Since then he has been engaged in private research work. Mr. Hand was a graduate of Hobart College and held a chemical engineering degree from Massachusetts Institute of Technology. Prior to founding Rubber Service Laboratories he was a development engineer for Goodyear Rubber Co.

✦ JOHN A. WILSON, consulting chemist, died September 10 in Doctors Hospital, after an illness of six months. His age was 52. Dr. Wilson, formerly of Milwaukee, was the winner in 1931 of the William H. Nichols Medal of the New York section of the American Chemical Society for outstanding achievement in colloid chemistry, applied particularly to leather and sanitation. In 1928, he received the Charles Frederick Chandler Medal in chemistry from Columbia University.

✦ JACOB F. SCHOELLKOPF, SR., a pioneer in the aniline chemical industry in this country, died September 10, at his home near Buffalo, N. Y. His age was 84. Mr. Schoellkopf founded in 1931 the Jacob F. Schoellkopf Gold Medal presented annually by the Western New York Section of the American Chemical Society to a scientist for a major advance in chemistry. He was a member of a family long prominent in Niagara Falls hydroelectric power development, and formerly was chairman of the Niagara Falls Power Co. now a subsidiary of the Niagara Hudson Power Corp., of which his nephew, Alfred H. Schoellkopf, was president.

BLENDED at 2800 Degrees!

Scientific sampling and blending of molten metal at 2800° F. may seem like needless "fussiness" in the making of pipe fittings. But it's the type of extra care that gives you *extra service* values in every piping product made by Grinnell.

Chemical analysis of metal from every heat, physical tests of samples, and photomicrographs of actual metal structure keep a constant check on production quality. Grinnell *Air Furnace* Malleable Pipe Fittings are stronger and more uniform because of such precautions.

It's this rigid quality-control from start to finish that gives you better-than-standard quality in any Grinnell product . . . automatic sprinkler fire protection systems, prefabricated piping, Amco humidification systems, Genspring pipe hangers or pipe fittings. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

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Grinnell Company, Inc. • Grinnell Company of the Pacific. • Grinnell Company of Canada, Ltd. • General Fire Extinguisher Company • American Moistening Company • Columbia Malleable Castings Corporation • The Ontario Malleable Iron Company, Ltd.

Daily chemical analysis

Daily physical tests

Daily metal control by microphotos

GRINNELL

WHENEVER PIPING IS INVOLVED

YOUR INTELLIGENCE

A T & M'S CENTRIFUGAL ENGINEERING SAVES TIME AND FLOOR SPACE FOR HUNDREDS OF FIRMS

Hundreds of manufacturers today are solving problems of tighter production schedules, scarcities of men and materials, rising costs — by *centrifuging*.

Manufacturers already using centrifugals find that A T & M can help them adapt or re-design existing machines to meet changed conditions, increase production, or lower costs.

Other manufacturers, discovering for the first time the surprising number of operations that can be speeded, simplified, or even eliminated entirely, by using centrifugal force, are now enjoying improvements both in quantity and quality of production — improvements which, in some cases, have revolutionized their outlook for the future.

Examples of the kind of achievement you can expect from A T & M are described on these pages. While concentrating today on certain well-defined war orders, A T & M engineers are ready to work with you on plans for *future* development, to get similar results.

Write us. We keep strict confidence. Address American Tool & Machine Company, 1415 Hyde Park Avenue, Boston, Mass., or 30A Church Street, New York, N. Y.

EXTRACTED: A Valuable By-Product. Residue from a manufacturing process was polluting a stream. After calling in A T & M engineers to devise a corrosion-proof, quick-discharging, quick-cleaning centrifugal to separate solid from waste, it was discovered that the reclaimed solid could be used again to produce a still better product.

SAVED: 50% Of A Water Bill. Using centrifugals instead of filters cut this manufacturer's water bill in half, but inability to get a "cake" of uniform thickness threatened his gains. A T & M engineers designed a special centrifugal using two perforated screens which made his centrifugal savings possible.

CLARIFIED: A Sticky Problem In Sludge. An expensive sedimentation and clarification process seemed inevitable until A T & M designed a free-wheeling device for this manufacturer's centrifugals which overcame the difficulty of sudden speed changes. And a specially-designed opening in the bottom of the basket also served to sidestep the need for slow, space-consuming equipment.

PRECIPITATED: A Rare Substance For A MASS Market. Difficulties in precipitating precious soluble salts from insoluble matter were referred to A T & M by an important manufacturer, with the proviso that A T & M should not try to analyze the substance, nor try to precipitate it. After centrifuging a quart, A T & M engineers discovered that merely by changing the centrifugal cycle higher recovery for mass production would be possible.

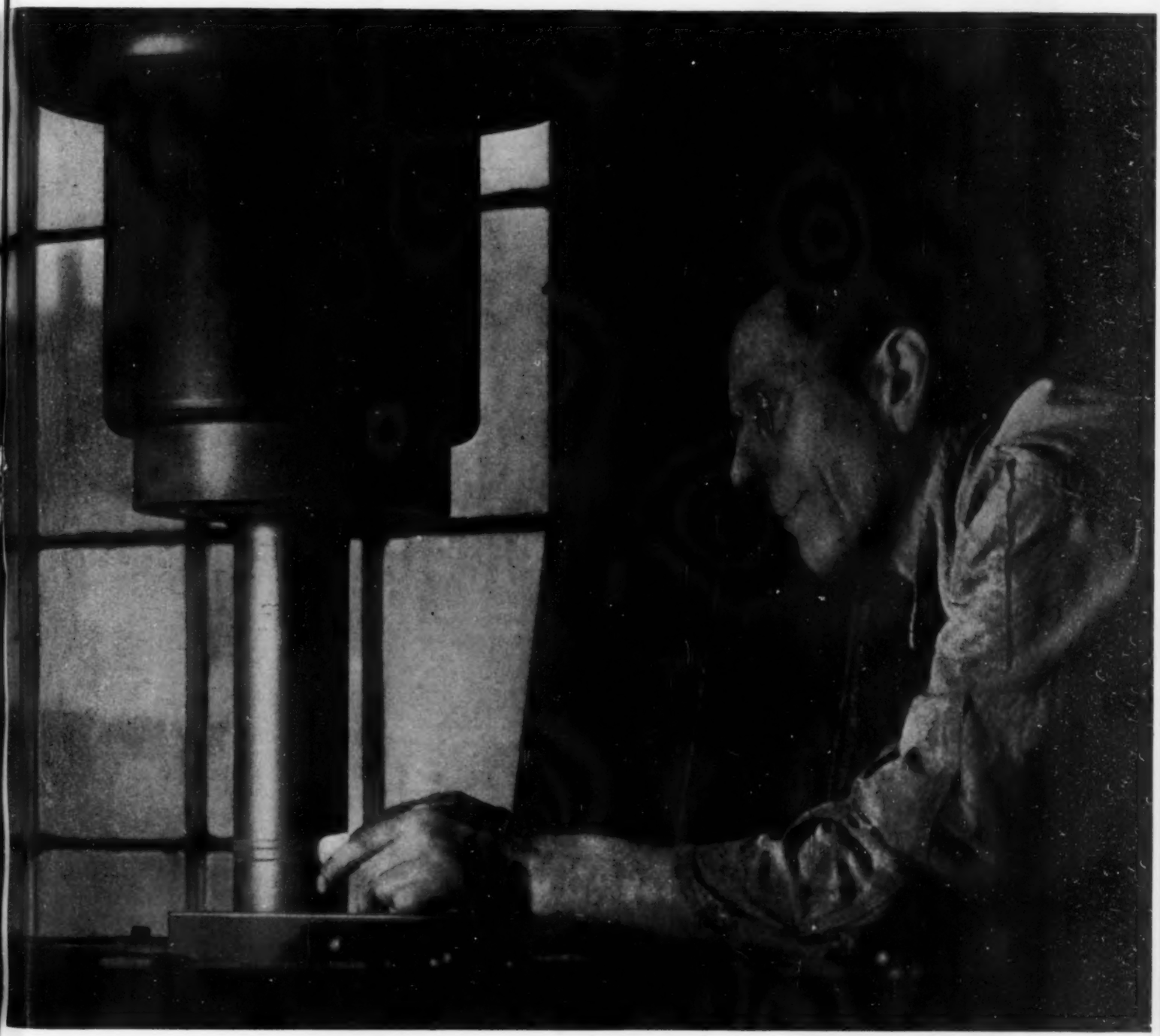
RESCUED: 1/6 Of Total Production. In separating crystals from a sticky fluid, part of the fluid was adhering to the curb, to be lost in the wash water. For this manufacturer, A T & M engineers devised a special valve, and extra outlet and a shield around the basket, which combined to save 1/6 of his total production.

WASHED: The Pores Of A Floating Metal. A metal so cellular that it floated had to be washed enough to bring down its pH value, using a minimum of water. Absolutely even cake distribution, and a new method of discharging the metal after it had been dried centrifugally, were further requirements of the job. For this puzzled chemist, A T & M engineers designed a spray arrangement, a new, special discharger, and established loading speed and total time schedules for quick, profitable production.

SQUEEZED: $9 Per-Gallon-Cost Out Of A $10 Product. If costs could be lowered, a tremendous medium-priced market would be reached by this manufacturer of a certain malaceous derivative used in cosmetics. A T & M engineers eliminated an entire operation through centrifugal squeezing and siphoning and designed a complete production line which lowered costs from $10 to $1 and made the wider market possible.

A T & M CENTRIFUGALS SAVE TIME AND SPACE IN ALL MACHINABLE METALS AND COATINGS

SERVICE FOR { EXTRACTION FILTRATION DEHYDRATION PRECIPITATION COATING



A. T. and M.

AMERICAN TOOL AND MACHINE COMPANY

Link Suspended A T & M Smooth operation with "out of balance" loads. An A T & M-designed link guarantees absolute minimum of foundation vibration. Fume-tight cov-

Suspended A T & M For heavy chemical service. Self-discharging baskets, Twin-Speed Regenerative Drive for entire batteries, positive control — and all other accessories

Base Bearing A T & M Motors built to A T & M's own specifications. Removable baskets, if desired. Cover cannot open while centrifugal is in use. Easily accessible brakes. Outer

Stainless Steel Castings

RESISTANT TO CORROSION, ACID, HEAT, ABRASION

Stainless steel alloy castings are recommended when corrosion is a factor to contend with. Atlas metallurgists have developed a most accurate method of determining the analyses best suited to individual requirements. Many Atlas foundrymen have been specializing in alloy steel castings for over twenty years. Their experience together with every known modern facility has been assembled for making the highest grade of corrosive, heat and abrasive resistant castings. Consult with us when your product is in the layout stage—our engineers can minimize your design problems.

Write for bulletin

ATLAS

STAINLESS STEEL CASTINGS

Division Atlas Foundry Co.

540 LYONS AVENUE IRVINGTON, N. J.

NEWS OF PRODUCTS AND MATERIALS

NON-SLIPPERY FLOORING

Insurance statistics show that deaths from falls total about 26,000 per year, or 28 percent of the year's total for all types of accidents, ranking second only to deaths from automobile accidents. Designed to produce non-skid floors, either wet or dry, Walter Maguire Co., New York, N. Y., is offering Cortland Emery Aggregate, a mixture of scientifically graded large and small, sharp, hard particles of mineral emery, rating next to diamonds in hardness. For application, the aggregate and nothing else is mixed with portland cement and water for the floor topping. Even when an emery aggregate floor is wet, it provides a firm non-slip gripping surface. This quality improves with wear, the floors actually becoming safer with use for as the rough emery particles are exposed by wearing away of the cement, their gripping action improves. Where loads are moved by hand-trucking operations, much greater pushing traction is obtainable. In addition, this flooring greatly increases the load-bearing qualities. An aggregate floor mixture specimen will support a load of more than 14,000 lb., while tests indicate that a standard test specimen of ordinary concrete floor mixture will break under a load of 6,200 lb. Heavy loaded trucks will not destroy the aggregate surface and the hardness of the emery particles resist wear.

PHOSPHOR

For use in coating fluorescent lamps, a new phosphor which produces more light and uses no cadmium or lead, has been developed by research engineers of the Westinghouse Lamp Division, Bloomfield, N. J. In the fluorescent lamp, the phosphor's function is to transform invisible ultra-violet rays into visible light radiations. The new phosphor, already being used in production of Westinghouse Mazda fluorescent lamps, has been found to maintain a high light output in the lamps, yet permits the elimination of cadmium and lead, two materials essential in the war effort. Westinghouse research engineers discovered that the lamps' light output could be increased by minute changes in the percentage of the activator element. This new mix produces substantially more light than the previous mixture that contained critical materials.

COBALT-NICKEL OXIDE

Recently offered for sale to the ceramic manufacturers for use in ground coat frits is a cobalt-nickel oxide compound produced by Ferro-Enamel Corp., Cleveland, Ohio. The company has been using this product in its own plant for several years. It may be used in the manufacture of ground coat frits for porcelain enamelware in place of cobalt oxide. Ferro cobalt-nickel oxide compound is refined in a plant which Ferro installed in 1940 for the refining of cobalt oxide. A representative analysis follows:

100 lb. compound contains approximately

60 lb. equivalent of cobalt oxide

20 lb. equivalent of nickel oxide

Fe_2O_3 less than	0.50%
CuO about	1.00%
MnO_2 about	1.00%
Calcium and sodium about	5.00%
Loss on ignition about	12.00%

PROTECTION AGAINST RUST

The development of non-adhesive Tygon formulations to provide easily removed temporary protection to highly polished surfaces against rust, corrosion, grease, fingermarks, dust scratchings and the like, has been announced by the United States Stoneware Co., Akron, Ohio. These new formulations consist of pure Tygon liquefied to form a stable non-adhesive film when dried. Tygon Temprotec is crystal clear or transparent colored formulations for ready identification purposes, is applied by brush, dip, spray or roller coating. It air dries within a few minutes at normal room temperature to form a sturdy, durable elastic film unaffected by oil, grease, gasoline or corrosive atmospheric fumes or condensates. Temprotec will not become brittle under sunlight, is unaffected by active oxidizing agents, water, alcohol or brine solutions. The manufacturer states that it easily strips free, peeling off as a complete film without danger of injury to the surface beneath. It provides excellent protection for surfaces of machine parts, tools, bearing surfaces, etc., during handling, shipping, installation; it is likewise an effective tarnish preventative for sterling silver, plated silver, chrome, nickel or gold, copper and other metals, while in storage, transit or on display.

HOG BRISTLES FOR BRUSHES

The establishment of a new industry in the United States was revealed recently announced by E. S. Phillips, president of Devoe & Raynolds Co., Inc. His company is now dressing domestic hog bristles for use in making brushes. Heretofore all hog bristle in the manufacture of brushes in this country was imported from the Far East, particularly China and Siberia. In 1941, approximately 6,000,000 lb. of dressed bristles were imported. Now, due to the conflict in the Pacific, imports of this vital raw material have been cut off. Progress made in the use of domestic hog bristles has resulted from many months of research, experimentation and coopera-

tive work between large packers and Devoe & Raynolds.

FLAME-RESISTANT INSULATING VARNISH

The recently developed flame-resistant insulating varnish designated as R-878, was developed by the Sterling Varnish Co., Haysville, Pa. It is recommended for Class B high temperature insulation. This new varnish is mechanically strong and dries all the way through when applied to electrical apparatus. After drying, R-878 will not support combustion, when the flame is removed, neither will it melt nor resoften under operating temperatures. In addition to good heat resisting qualities, it has all the characteristics of a high grade insulating varnish.

PLASTIC-COVERED CONDUIT

A flexible, plastic-covered conduit under the trade name of Amerflex has been announced by Searle Aero Industries, Inc., of Orange, Calif. The use of this plastic covering instead of rubber for insulation helps reduce the weight of the conduit. Amerflex is used principally in planes, tanks and boats to protect the electrical assembly from gasoline and oil. The plastic skin over flexible metal conduit protects the conduit itself and the wires inside against abrasion, heat and most solvents, including gasoline and oil. Because of flexibility, toughness and resistance of the plastic covering the product has longer life than rubber-covered conduit. This is made in sizes from $\frac{3}{16}$ in. I.D. to $1\frac{1}{4}$ in. I.D.

ALKALINE COPPER PLATING PROCESS

Copper deposited with the Unichrome alkaline process of United Chromium, Inc., New York, N. Y., presents a fine-grained, homogeneous structure with excellent adherence and extreme smoothness, it is stated. The density of the deposit plus its easy flow in forming operations make it especially suitable as a stop-off during carburizing or as a lubricant in deep-drawing of steel. In addition there is no hydrogen embrittlement encountered with plating with this bath. Thick or thin coatings are produced quickly and easily within reasonable tolerances of required dimensions. Some installations are being run at speeds in excess of 20 min. per 0.001 in. of copper deposited yielding greatly increased production per unit of equipment. The plating bath is a mildly alkaline bivalent copper solution operated at a pH of about 8.5 electrometric. The constituents of the bath are stable and easy to control. Throwing power is said to be excellent. The bath contains no cyanide, brighteners, wetting agents and special addition agents are not required.

ALKALINE STRIPPING BATH

Developed by United Chromium, Inc., this new process is of assistance in meeting the problem of removing copper from steel. The particular advan-

A NAME EVERY ENGINEER SHOULD KNOW

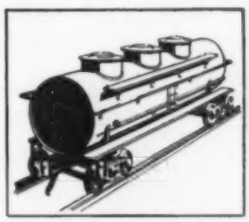
Millions of gallons of Diesel Fuel, in storage at strategic points, are protected by *Amercoat*—the cold-applied plastic base coating. In this application, *Amercoat* seals the concrete tanks used for storage and, at the same time, protects the fuel from contamination. Thus, *Amercoat* permits the use of concrete for storing vital fuel supplies and releases critical metals for other urgent needs.

HUNDREDS OF SUCCESSFUL APPLICATIONS

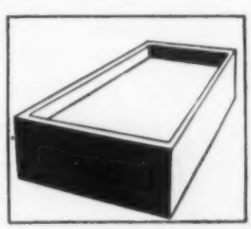
This is just another typical example of how *Amercoat* has solved successfully many different problems pertaining to corrosion and contamination in the Food, Mining, Dairy, Chemical, Petroleum, Maritime and other industries.

Tell us *your* problem and we'll answer it with *Amercoat* to fit your specific needs; or we will tell you that *Amercoat* is not the answer.

Write for Illustrated Booklet giving complete information on Amercoat and its many applications.



FOR METAL



FOR CONCRETE

Amercoat is odorless, tasteless, chemically inert and dielectric to a high degree. It is effective on either concrete or metal.

Amercoat DIVISION

AMERICAN PIPE AND CONSTRUCTION COMPANY

P. O. BOX 3428 TERMINAL ANNEX, LOS ANGELES, CALIFORNIA

TIME IS UP....

but not for the average

WARREN PUMP

many of which go on indefinitely after their "life expectancy" span. The reason: Warren never compromises with sound engineering principles, cheapens at the expense of reliability, barters safety for price advantage or recommends along the border line.

These brief case-histories are typical of Warren Pump longevity:

June 15, 1901 . . . . . A Warren Horizontal Duplex still doing duty with a Coast Guard Unit.

November 28, 1899 . . . . . A Warren Horizontal Duplex Pump originally sold a municipality but of late years in service at a rendering company.

October 2, 1899 . . . . . A Warren Duplex Pump still on duty at a Connecticut brass works.

1901 and 1911 . . . . . Two Warren Hydraulic Pumps still on the job at a Pennsylvania cork products manufacturer.

1924 . . . . . Two Warren steam-driven vacuum pumps on duty for past eighteen years, 24 hours a day, 365 days a year.

Warren also manufactures a complete line of Centrifugal Pumps.

Whatever type of Warren Pump you select, you can be sure of getting dependability and long life.

WARREN PUMPS

Warren Steam Pump Co., Inc., Warren, Mass.

tages of this process include: First, it is exceedingly fast compared to older methods. Coatings up to 0.001 in. can be removed in 10 min. or less. Second, the bath is a mildly alkaline, non-toxic solution and does not etch the steel base metal. This property is valuable where maintenance of the finish and avoidance of pitting are essential.

RUBBER SUBSTITUTES

A new synthetic which is replacing rubber in army raincoats and which it is expected will soon replace rubber also in many other products using waterproofed fabric, has been announced by the Stanley Chemical Co., of Berlin, Conn. The product is known as Haydenite.

TURBINE OIL

A recent outgrowth of unusual war needs of the U. S. Navy has been the call for a radically new type of marine turbine oil which combines powerful rust preventive properties with superior oxidation stability. This new oil has been developed after several years of research work by Shell Oil Co. It will eventually be supplied to all United States battleships, etc., and was subjected to severe service tests by Navy engineers.

EMULSIFIED LUBRICANT

Announcement has been made of a true water phase emulsion in concentrated form by the Crowe Chemical Co., Tulsa, Okla. For use it is mixed one part of the concentrate with three parts of battery water. It is said to be neutral, contains no alkalis or solids. It can be used for lubricating all rubber parts of automotive equipment for removing and prevention of corrosion on battery terminals. It is an excellent penetrant for ready removal of stock nuts, etc. It is also claimed to be harmless to natural or synthetic rubber and can be used as a lubricant for all types of power belts.

METAL CLEANING SOLUTION

Metal cleaning, always complex, has become more of a problem with the current scarcity of chlorinated solvents and more exacting specifications. Sodium metasilicate as a versatile cleaner is meeting the new requirements on its own and also in combination with other materials. A recent formula worked out for difficult metal cleaning of light steel uses a 1 percent solution composed of 19 parts sodium metasilicate (Metso) and 1 part alkyl aryl sulfonate (Nacconol NR). The latter material reduces surface tension and assists the Metso solution in the removal of the grease film with only 2 seconds contact.

CLOTH AND BURLAP SUBSTITUTES

A significant aspect of the war time search for substitutes is the use of paper to replace priority materials.

One of the most interesting is Aqualized paper, a product of the Brown Co., New York, N. Y., which is suggested as a substitute for cloth and burlap. The name was suggested by the paper's unusual strength when wet, a feature not found in ordinary papers which tend to lose strength and disintegrate in contact with water. Fibers in the paper are effectively interlocked and fastened, giving an inherent wet strength all the way through the sheet that is independent of any coating or sizing on the surface of the paper. Some types of Aqualize paper are highly absorbent; other types, on the contrary are made to repel water.

COMPLETELY DEHYDRATED PAINT

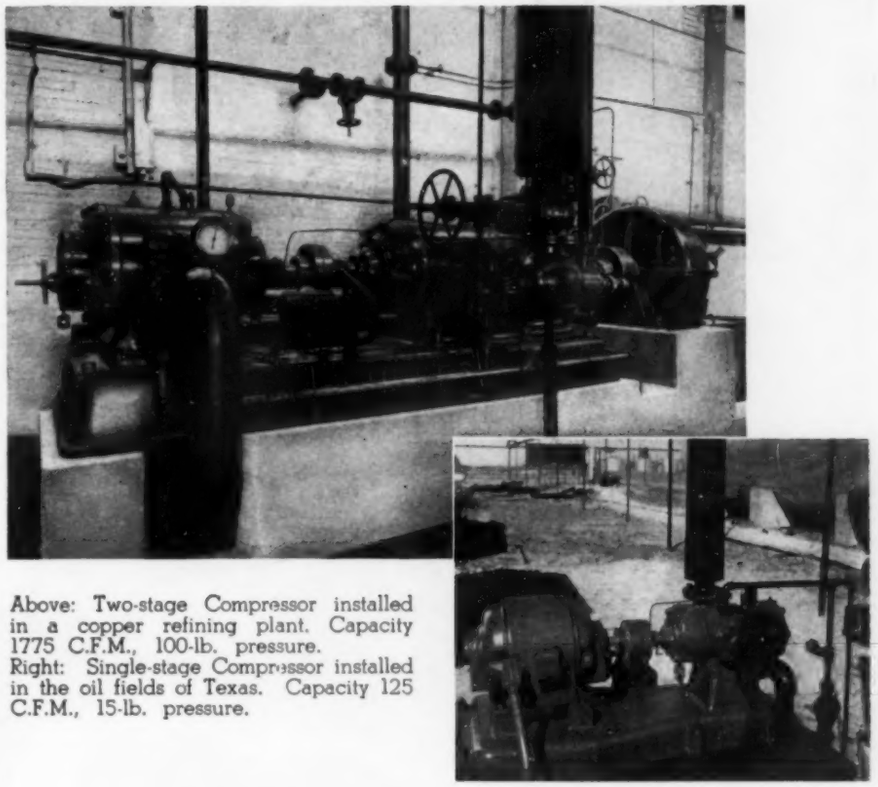
The development of a completely dehydrated paint called Dehydray has been announced by Devoe & Raynolds Co. It weighs about half as much as liquid paint and bulks considerably less. It is in line with the government's effort to cut down on freight space to make more room for shipment of vital war materials. Among the advantages are:

1. The customer buys no water at all —he uses his own.
2. The product is packed in cardboard cartons, avoids priorities on cans or other containers, cannot freeze.
3. Saves vital shipping space and freight costs.
4. Has excellent washability which means easy cleaning when dirt collects on walls.
5. Covers almost any kind of interior wall surface including wallpaper, cement, wallboard, paint, brick and plaster, usually with one coat.
6. Has every advantage found in the new resin-emulsion paints.
7. Costs the consumer less because he does not pay paint prices for water. Savings on shippings and containers are also passed on to the consumer.

TINLESS TIN CANS

Tinless tin cans, grown on the farm and cattle range, were announced recently by the Macmillan Petroleum Corp., Los Angeles, as they announced the development through chemical research of the first all-fiber plastic-lined container which is impervious to oil. The container is produced by direct processing of such surplus crops as corn, other grains, flaxseed, tallow, animal tissues, bone and clay, and the basic fiber is made from straw and waste paper. The new container means a saving of 10 percent in weight over cans previously used, thus permitting more oil to be shipped per freight carload. More importantly, they eliminate the need for tank cars and for the return shipment of empty drums in the distribution of lubricating oil. Macmillan's primary interest in the development is that it will continue to make available to consumers oil that has been packaged and sealed at the refinery.

Built in sizes to meet your requirements



Above: Two-stage Compressor installed in a copper refining plant. Capacity 1775 C.F.M., 100-lb. pressure.
Right: Single-stage Compressor installed in the oil fields of Texas. Capacity 125 C.F.M., 15-lb. pressure.

Single and Two-Stage Units . . . Capacities to 1800 C.F.M., 125-Lb. pressure

There's a Fuller Rotary Compressor that will meet your requirements. Built for direct motor or gas-engine drive without speed reduction, and for geared-turbine drive, they offer dependable service, keep maintenance at a minimum . . . in the long run, lower operating costs. Original capacities maintained for the life of the machine, plus many other inherent advantages, warrant your thorough investigation.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago: 1144 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

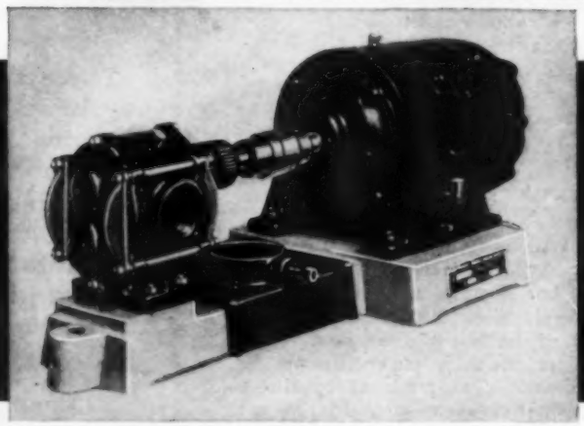
C-63

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

ACE Hard Rubber helps safeguard America on land...on sea ...in the air

•

Rugged, precision parts of Ace hard rubber—all with these advantages: Acid and Alkali Resistant . . . Dependable . . . Economical . . . Non-Hygroscopic . . . Adaptable for integrally molded metal parts...Easily machined, turned and finished.



Ace hard rubber Rotary Gear Pump, Type G. Applicable to a range of uses from laboratory work to factory pumping problems. Capacity 9 gallons per minute. Also Ace hard rubber Centrifugal, Single Acting and Double Acting pumps.

ACE

American Institute of Chemical Engineers to Convene in Cincinnati

CHEM & MET NEWS OF MEETINGS & CONVENTIONS

A.I.CH.E. PLANS PROGRAM FOR CINCINNATI MEETING

THE AMERICAN Institute of Chemical Engineers, holding its 35th annual meeting at the Netherlands Plaza in Cincinnati, Nov. 16-18, is now making arrangements for papers to be presented in the technical sessions. Among those already in prospect are papers dealing with the mechanism of drying in solids, mass and energy transfer in granular solids, air drying of hydroscopic solids, drying of rayon, liquid-lhquid extractions, effect of vapor load on plate efficiency in fractionating columns, plant data on distillation column plate efficiency, batch distillation, high vacuum distillation, distillation column calculations, distillation of multi-component mixtures.

Papers dealing with flow phenomena include laminar flow of cold-oil suspensions, weir flow in overflowing tanks, and theoretical flooding velocities in packed columns. Also tentatively scheduled are papers dealing with vapor-liquid equilibria, thermodynamic properties of air, mixed acid and nitration processes, purification of molasses for fermentation, holdup in packed columns, viscosity of propane-lubricating oil mixtures, and principles of stripping operations.

The preliminary schedule also includes a discussion of industrial electrolytic chlorine cell construction, Cincinnati chemical industries, safety in explosives plants, plant protection in wartime, concealment by means of protective smokes and camouflage for industrial plants.

NATIONAL CHEMICAL EXPOSITION ANNOUNCES PROGRAM

PROGRAM FOR the 1942 National Chemical Exposition, to be held at the Sherman Hotel in Chicago, Nov. 24-29, has recently been announced. On Nov. 28 there will be a symposium on industrial war problems, presided over by C. S. Miner, of Chicago. Included are papers on control of wartime incendiaries by W. V. Evans of Northwestern University, waste treatment in industry as related to war economy, by F. W. Mohlman, director of laboratories, Sanitary District of Chicago, and salvage and conservation of chemicals in industry, by S. D. Perlman, of the Industrial Salvage Section of the War Production Board.

Other sessions will include the subject of plastics and paper, presided over by Norman L. Shephard of American Cyanamid Co., and food and the relation of food to the chemistry of plants and the soil, presided over by C. G. King, of the Nutrition Foundation, Inc. Also scheduled are papers dealing with the use of the electron microscope and the cyclotron in chemical research.

In addition, the War Production Board is preparing a special exhibit to demonstrate reclamation and recovery of solvents, paints, oils of all kinds, toluol and chemical by-products. W.P.B. is anxious that everyone concerned with industrial production see this special exhibit since more and more attention will have to be paid to salvage and conservation as the war continues.

A continuous program of industrial movies will be shown during the exposition. These films show interesting features of the manufacture of plastics, rayon, chemical stoneware, glass, coke, white lead, gelatine, cap screws, steel and aluminum, as well as miscellaneous subjects related to chemistry in the field of photography, natural resources and special plant construction.

"Successful Alternates and Substitutes" will be the subject of an extensive exhibit now being prepared by Dr. Harrison E. Howe, editor of *Industrial & Engineering Chemistry*. This exhibit will show the old and the new. Dr. Howe will also have an exhibit showing "The Chemist's Part in Civilian Defense." In addition, the "New Chemicals" exhibit by W. J. Murphy of *Chemical Industries*, takes on added significance at this time.

TECHNICAL SESSIONS OF A.S.M.E. FALL MEETING SCHEDULED

TECHNICAL SESSIONS of the fall meeting of the A.S.M.E., scheduled to be held at the Sagamore Hotel in Rochester Oct. 12-14, include a number of papers of interest to chemical engineers. Among such papers are those deling with the effect of wood structure upon heat conductivity, making plywood with multi-directional pressure, high-density plywood, training women for engineering jobs, rod curtain type electrostatic precipitators, elimination of carry-over in steam under steel-mill operating conditions, photocopying methods in engineering, improved hydraulic presses, materials handling methods in war production program, conservation of critical materials, and handling of scrap.

INDUSTRIAL HYGIENE FOUNDATION TO MEET IN PITTSBURGH

THE SEVENTH annual meeting of the Industrial Hygiene Foundation is scheduled for Mellon Institute, Pittsburgh, Nov. 10-11. The program, to center around ways for reducing manpower waste in the face of a threatened labor shortage, will drive for action in reducing the approximately 2½ million days war workers are losing weekly from illness and non-industrial injuries. The Foundation will give specific recommendation for reducing this wasted manpower and for increasing the health and hence the output of workers in war industries.

INDUSTRIAL MINERALS DIVISION OF THE A.I.M.E. TO MEET

MEMBERS OF the Industrial Minerals Division of the American Institute of Mining and Metallurgical Engineers will discuss the importance of South America as a source of industrial minerals at their dinner at the Hotel Bethlehem, Bethlehem, Pa., Friday evening, October 23. Charles W. Wright of the Board of Economic Warfare will

CALENDAR

OCT. 27-29	National Safety Congress and Exposition, 31st annual meeting, Sherman Hotel, Chicago, Ill.
NOV. 9-13	American Petroleum Institute, 23rd annual meeting, Palmer House, Chicago, Ill.
NOV. 16-18	American Institute of Chemical Engineers, 35th annual meeting, Netherland Plaza, Cincinnati, Ohio.
NOV. 24-29	National Chemical Exposition and National Industrial Chemical Conference, Sherman Hotel, Chicago, Ill.
DEC. 1-4	American Society of Mechanical Engineers, annual meeting, Hotel Astor, New York, N. Y.

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at fraction of the cost in

The ILLCO-WAY method of purifying water is one of ion exchange, using Amberlite synthetic resins to produce a final effluent which compares very favorably with heat distilled water. The water is not evaporated, so no heat is used in the process which is daily meeting the exacting standards of industrial and technical concerns requiring purified water.

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LOW COST — The cost of the treated water is amazingly low — *less than a dollar per thousand gallons*, on the average water supply. And when the supply is low in dissolved solids, the cost may be considerably less.

No heat used—No fuel required!

Operation is completely automatic (between periodic regenerations). Pipes will not lime up. Maintenance costs are reduced to a minimum. A unit delivering 300 gallons an hour occupies a space about 4 x 10 feet. Made of finest materials to protect the purity of water. Available in units affording from 120 gallons an hour to 50,000 gallons an hour.

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speak on "South America as a Source of Strategic Metals." An informal discussion will be led by J. T. Singewald, Jr. of Johns Hopkins University, and Paul M. Tyler of the Board of Economic Warfare. The dinner will be the feature of the Division's fall meeting, October 22-24.

NATIONAL SAFETY COUNCIL TO MEET IN CHICAGO

THE THEME of the 31st National Safety Congress and Exposition, to be held in Chicago, October 27-29, will be that of saving manpower. The entire program, covering every phase of safety, with 175 sessions and 500 program participants, will be centered on the problem of stopping accidents that slow production, impede the movement of troops and supplies, and waste manpower, material and time.

The Congress, the annual convention of the National Safety Council, is the largest safety event in the world. Attendance averages 10,000, and safety leaders from all parts of the country assemble. Delegates this year will cram the program into three days, instead of the usual five. Headquarters will be the Hotel Sherman in Chicago, but sessions will also be held in the Morrison and La Salle Hotels. An exhibit of all types of safety appliances and equipment will be a feature of the Congress.

POWER EXPOSITION TO BE HELD IN MADISON SQUARE GARDEN

ANNOUNCEMENT has been made that the 15th Exposition of Power and Mechanical Engineering, scheduled to be held in Grand Central Palace, November 30-December 5 will be transferred to Madison Square Garden in New York.

More than 150 exhibitors have taken space in the Power Show and space and arrangements of exhibits will be on a basis similar to the original plans. Charles F. Roth is manager of the exposition and particulars regarding space may be obtained at headquarters, 480 Lexington Ave., New York.

TECHNICAL MEETING NOW BEING SCHEDULED

AMONG THE TECHNICAL association meetings and conventions of interest to chemical engineers and industrial chemists now being planned for the fall months are the following:

Engineers' Council for Professional Development, 10th annual meeting, New York, N. Y., Oct. 18.

National Safety Congress and Exposition, 31st annual meeting, Sherman Hotel, Chicago, Ill., Oct. 27-29.

Electrochemical Society, fall meeting, Hotel Statler, Detroit, Mich., Oct. 7-10.

American Welding Society, 23rd annual meeting, Hotel Cleveland, Cleveland, Ohio, Oct. 12-16.

American Society of Mechanical Engineers, fall meeting, Rochester, N. Y., Oct. 12-14.

American Society of Tool Engineers, semi-annual meeting, Springfield, Mass., Oct. 16-17.

American Petroleum Institute, 23rd annual meeting, Palmer House, Chicago, Ill., Nov. 9-13.

Industrial Hygiene Foundation, annual meeting, Mellon Institute, Pittsburgh, Pa., Nov. 10-11.

American Institute of Chemical Engineers, 35th annual meeting, Netherland Plaza, Cincinnati, Ohio, Nov. 16-18.

Canadian Institute of Mining and Metallurgy, 24th annual western meeting, Vancouver, B. C., Nov. 18-20.

National Chemical Exposition and National Industrial Chemical Conference, Sherman Hotel, Chicago, Ill., Nov. 24-29.

American Society of Mechanical Engineers, annual meeting, New York, N. Y., Nov. 30-Dec. 4.

National Exposition of Power and Mechanical Engineering, Madison Square Garden, New York, N. Y., Nov. 30-Dec. 5.

American Institute of Electrical Engineers, Winter convention, New York, N. Y., Jan. 25-29, 1943.

American Institute of Mining & Metallurgical Engineers, 157th annual meeting, New York, N. Y., Feb. 14-18, 1943.

SELECTIONS FROM CONVENTION PAPERS

SELECTIVE SERVICE AND THE CHEMICAL ENGINEER

ENTIRELY TOO FEW trained chemists and chemical engineers realize that their services are much more badly needed in the chemical plants and laboratories of the nation than in the armed forces. The chemical man-power shortage has already assumed serious proportions and the situation will become much worse as the huge plants now being constructed for manufacture of synthetic rubber and its raw materials, aviation gasoline, TNT, toluene, chemical warfare agents, aluminum and magnesium, alcohol and many other war essentials actually begin large-scale production. According to one source, last year industry asked for four times as many young engineers as the universities and technical schools could provide. This year the need will be greater and next year greater still.

There are in this country, according to registration in the National Roster of Scientific and Specialized Personnel,

WE CAN SHIP YOUR BLUE ASBESTOS PACKING TODAY

We've stepped up our service facilities to keep pace with war requirements . . . to serve everyone as promptly as possible. To date, no one has had to wait for Supercutno or dry blue asbestos packing.

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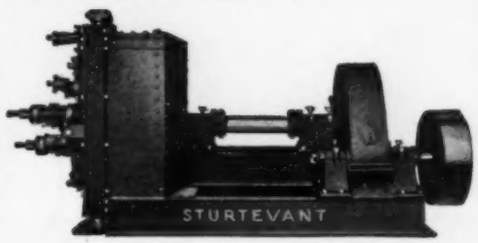

Have You a Pulverizing Problem That Calls for Exactness?

AND AIR SEPARATOR

Today, industries producing finely ground material cannot be satisfied with the old haphazard methods of grinding and separating. No longer will a product "somewhere-near" be acceptable. It must be of a sustained and dependable exactness; and right here is where the Sturtevant Ring-Roll Mill and Air Separator closed-circuit unit is solving such problems.

The output, on suitable material is from 4 mesh to 200 mesh. Screens are usually used in place of Air Separators on products ranging from 4 mesh to 50 mesh. Air Separators from 50 mesh to 200 mesh. The feed may be from ⅛" to 1½". The capacities, according to size of mill and fineness of product, are from 1 ton to 25 tons per hour.

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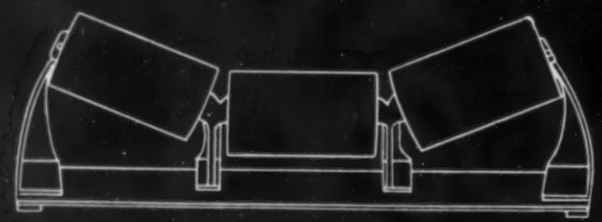
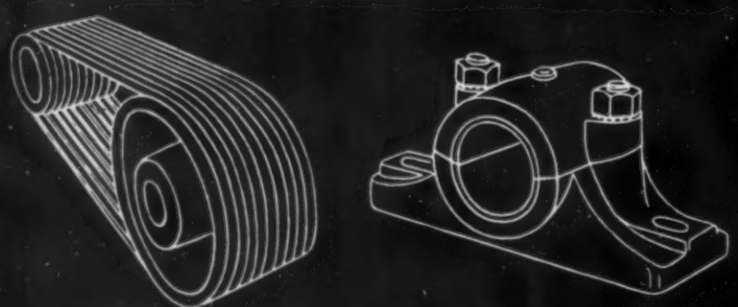


POWER TRANSMISSION



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only some 250,000 chemists, physicists, engineers of all types, bacteriologists, geologists, metallurgists and other scientifically trained men from the graduating classes of 1942 up to 80 years of age. Yet, according to Chairman McConnell of the Engineers Defense Board, at least one of the many behind-the-line workers for every man in uniform should have technical training.

Of the above scientific "pool," slightly less than 70,000 are chemists, chemical engineers and other chemically trained personnel, of which only 15,000-20,000 are chemical engineers. It is believed that Germany proper had 100,000-125,000 chemically trained men before the present war. Now the trained personnel of practically all of Europe is at the disposal of the technically-minded Axis war machine.

In spite of this dangerous shortage of chemical man-power, there is still induction of such men into the armed forces. Responsibility for this is divided between misinformed local draft boards, some employers, and the chemists and chemical engineers themselves. It would be foolish for this country to be driven again to the World War I experience of having to comb through army units to pull out chemical men for return to the munitions factories. Yet this may happen unless all three determining factors (local boards, employers, employee) grasp the fact that every properly trained chemist and chemical engineer is already in "essential" work or should be given a fair opportunity to get into such activity.

All chemically trained registrants seeking occupational deferment should consider it their patriotic duty to *exhaust all* the following steps before permitting themselves to be drafted into the army:

1. On receipt of the Selective Service Questionnaire, *immediately* file with the local board a sworn statement of the facts, including a request for deferment.
2. Register immediately, if this has not already been done, with the National Roster of Scientific and Specialized Personnel, Washington, D. C.
3. Within ten days after receiving notice of 1-A classification, make a written request for a hearing before the local board to state your case.
4. If the local board still denies deferment, *immediately* file a personal appeal to the Appeal Board, stating the facts simply but completely.
5. If the appeal is denied, *immediately* do the following:
   (a) Determine from local board probable date of induction.
   (b) Send this information to the National Roster by telegram.
   (c) Request by telegram the State Director of Selective Service to investigate your case.
   (d) Have your employer request the Regional Adviser on Occupational Deferments to investigate your case.
6. If the state appeal still does not obtain the 2-B or 3-B classification, then

• • •

The pressures of this war are compressing into the space of months scientific developments that might have taken us half a century to realize if necessity had not forced the pace. Those pressures are unprecedented. The developments are unprecedented. Give us a victorious peace and the freedom of enterprise it should guarantee and our progress will be unprecedented!

Perhaps the greatest benefit that has come to America from our chemical awakening is the renascence of all science that has accompanied it.

• • •

request the local board to delay the induction date.

7. Attempt to obtain an essential job before notice of induction is received. If this is done, your case *may*, at the discretion of the local board, be reopened and considered anew and steps 4, 5 and 6 again resorted to, if necessary (sections 626.2 and 626.3 of the Regulations).

There are several minor points which may also be helpful for the registrant to remember:

1. It is of vital importance to be patient and considerate with the local board under all circumstances and to keep in mind the tremendous responsibility and complicated situations with which its members must cope.
2. Simple "off-the-record" talks with members of the local board can often bring about better mutual understanding of the situation.
3. The registrant has the privilege of examining at any time his own personal selective service file.
4. Statements and requests to the local or appeal boards should always be signed in affidavit form.
5. All questions from the local board, written or oral, should be answered immediately *in writing*.

One important factor in requesting deferment for occupational reasons, of course, is the question of "replaceability." At the present time, even in cases where a man can be replaced, this should mean little with chemically trained personnel since the new man must be taken from another position where he is also needed. In other words, the total number of chemists and chemical engineers falls far short of actual needs, both now and for the duration of the war, so that every competent chemical man is "essential" in the sense that he is already doing "essential" work or could do so at any time. It is, of course, up to the individual to see that he is actually in such work.

• • •

Oils and Oil-Bearing Materials Imported from Latin America, 1938-40[1]

	1938	1939	1940
	Expressed in 1,000 lb.		
Argentina			
Flaxseed	803,168	855,538	552,806
Glycerine	2,061	2,910	2,966
Cottonseed cake	.....	.....	3,951
Peanut cake	.....	.....	6,114
Brazil			
Babassu kernels	50,826	113,836	98,272
Carnauba wax	12,343	16,351	16,925
Castor beans	113,029	161,926	163,116
Cottonseed oil	51,963	23,022	11,359
Murumuru kernels	4,101	7,504	6,001
Oiticica oil	5,300	18,866	15,536
Tucum kernels	2,328	9,810	5,032
Cottonseed cake	.....	.....	60,868
Haiti			
Castor beans	818	326	1,321
Cottonseed cake	.....	.....	2,955
Mexico			
Candelilla wax	1,411	3,357	5,644
Copra cake	.....	4,060	2,416
Cottonseed cake	6,590	9,979	20,630
Soybean cake	.....	.....	7,444
Peru			
Cottonseed cake	.....	.....	1,033
Uruguay			
Flaxseed	49,931	37,012	105,327

[1] K. S. Markley, Southern Regional Research Lab., Bureau of Agricultural Chemistry and Engineering, U. S. Dept. of Agriculture, New Orleans, La. before the Inter-American Conference of Agriculture, Mexico, D. F., July 6–16, 1942.

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REMEMBER the first time you ever tried to solder something? The hot little bubbles ran every place except where you wanted them until you were tempted to use your fingers but didn't dare. Molten solder gave you plenty of trouble then and it can give plenty of trouble to a manufacturer now unless he has the right pumping equipment for processing.

Quimby Pumps handle molten solder successfully and profitably with minimum maintenance and attention. They are used daily for this and many other unstable liquids such as wax, asphalt and nitrocellulose that require expert control. Extremes of temperature, viscosity and physical or chemical characteristics are typical of the pumping problems solved by Quimby engineers during the past half a century. Consult them with confidence.

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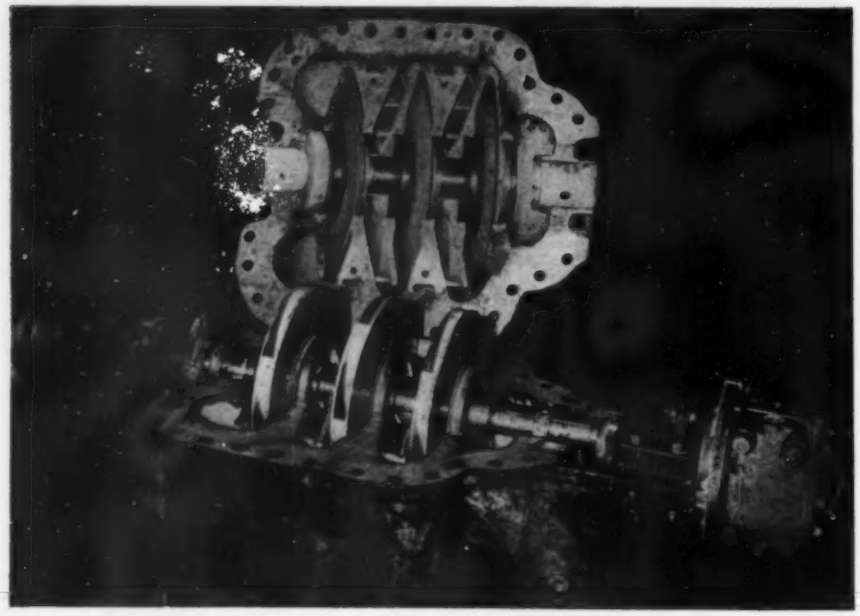
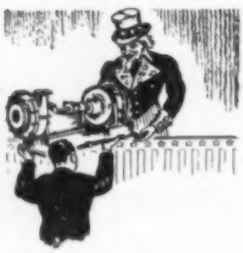


"Devil's Water" they called it, but it couldn't harm this MORRIS Pump

See any wear on the impeller or casing of this MORRIS Pump? The photograph was made on opening the pump after 19 years of handling acid mine water . . . "the worst in our section of Pennsylvania", said the mine superintendent. No repairs or replacements were needed anywhere on the pump.

This is the kind of performance that MORRIS Pump users are accustomed to, even in difficult operating conditions, for MORRIS Pump construction, like MORRIS Pump design, is based on 78 years of experience in building for the "hard-to-handle" services.

WE HAVE ENLISTED  "FOR THE DURATION"

We have placed at the disposal of the Government all our facilities that might be of use in the national war effort. But our remaining facilities are at your service, and also the advice of our engineers to help you secure best results from your present equipment and to plan for your future needs.

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CENTRIFUGAL PUMPS

It is believed by most well-informed circles that the best interests of the war effort lie in the retention by industry, through draft deferments, of all technically trained personnel, and in the realization of this fact by the very men themselves.

Alvin S. Weiss, chemical engineer, before the Junior Chemical Engineers of New York, New York, September 10, 1942.

RESEARCH IN INDUSTRY

THE OLDEST industrial research laboratories in this country are only some 50 years old, and the largest majority have been started within the past 25 years. The successful development of the corporate form of business occurred only slightly before this time and it seems that industrial research has been most successful under the conditions that a business corporation can offer. The most important of these are a sufficiency of funds to insure favorable working conditions for the scientific personnel, facilities for adapting the discoveries to manufacturing conditions, association with experts in other commercial branches and most important of all, competent, sympathetic management.

There is more perspiration than magic in completing a successful research program. The deserved success of research in industrial fields has come principally from the work of those scientists who have translated the perserverance, inspiration and intellectual honesty of academic, scientific research to the field of practical affairs.

Probably not more than one research project out of every 100 given preliminary study in industrial laboratories ever gets into highly successful commercial operation. Ten of the original 100 may pass the preliminary investigation and of these, in addition to the one highly successful project, there may be two or three minor successes. Today, at least qualitatively, industrial research must be conducted on a statistical basis.

A research worker of unquestioned ability may have a succession of scientifically excellent ideas, all of which may fail eventually for some engineering or economic reason. If he is his own financial supporter, the result may be very unfortunate. If a sponsor with larger resources supports these researches, he can tide over the run of unfortunate selections and eventually the percentage of successful projects will balance out. There is a great, inherent advantage in the system which permits mistakes on a small experimental scale while the successes are sifted out for repetition on a commercial scale. This advantage is great in comparison with the disadvantages and it has been an important factor in the rapid spread of research into almost all branches of industry.

No longer can one man, be he chemist, physicist, engineer or other specialist, personally conduct all experimental phases of a major industrial research program. Research squads are

now used which combine various types of talent necessary for successful solution of the problem. Thus another step away from the day of the independent inventor is taken. In the future there will undoubtedly be closer cooperation between chemistry, physics, engineering and other sciences than there has been in the past.

Those familiar with the patent laws of this country agree that the protection offered has been a most important stimulus in the application of science to industry and an indispensable factor in the development of our present industrial age. Without the protection from imitators thus provided, the expense of maintaining industrial research laboratories and the further expense of providing plants for the manufacture of new products would be seriously questioned by financial supporters who freely advance funds for such purposes. Great business successes have grown out of this understanding between the public and its benefactors. It must be remembered that the public also benefits and that only the inventor's part of the bargain expires with time.

If we analyze, item by item, in what our economic strength consists, we find that a preponderating amount of it is the result of applied science. In most cases the discoveries were made in the interest of peaceful activities, but in view of the excellence of their performance they have been adapted to military uses. So effective are the results of industrial research in conducting modern warfare that the charge has been made that science is the cause of war. It is reassuring that history does not confirm this accusation, as at many times in the past, vindictive and devastating warfare has been waged with whatever arms were then available.

Once the efficacy of applied science has brought a lasting peace, it can be quite as effective in restoring the damage suffered and in leading us on to a brighter future. The new frontiers opened up by industrial research stretch far beyond our present horizon and the mutually stimulating cooperation between such research and the American people can literally give us a future of our own choosing.

George O. Curme, Jr., Director of Research, Carbide and Carbon Chemicals Corporation, New York, N. Y., at the dedication of the new Technological Institute of Northwestern University, Evanston, Ill., June 15-16, 1942.

TECHNICAL DEVELOPMENTS OF THE ELECTRODECANTATION PROCESS

STRATIFIED separation of colloidal dispersions during undisturbed electrodialysis was first described by Pauli and named "electrodecantation". A technical process was developed with Ernst Schmidt by making use of the fundamental phenomena and of the laboratory technique used by Pauli and collaborators.

Stratified separation is due to the action of gravity on concentrated lay-

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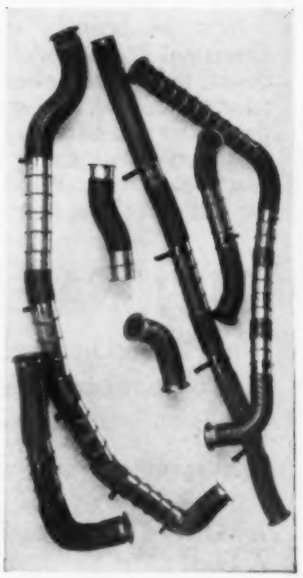
In REX Flexible Metal Hose you have an immediate solution for your re-design problems where compactness and flexibility are imperative. Plus this, you conserve materials because REX Flexible Continuous Lengths Metal Hose eliminates the need for long lengths of piping and pipe joints. It enables engineers to simplify designs—provides the means for solving fluid and gas handling problems—speeds manufacture by facilitating assembly. There are easily attached fittings for every requirement. REX Flexible Metal Hose withstands flexing and vibration and assures better product performance.



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REX-TUBE Interlocked Flexible Metal Hose.
REX-FLEX Stainless Steel Flexible Tubing. AVIO-FLEX Oil Line Hose. CELLU-LINED Hydraulic Hose.

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The Pennsylvania Turnpike—the world's most modern road; the prophecy of highways to come—is ready for fire anywhere along its 160-mile length!

And it got *ready* . . . as the road was being built . . . through the foresight of the Turnpike Commission and the engineering facilities of National Foam System, Inc.

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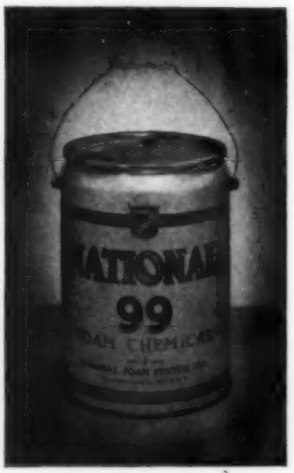

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Alcohol, ether, ketones, esters and mixed polar solvents immediately break down ordinary foam bubbles. *Yet they can't touch National "99".* Every test has shown that! Listed by the Underwriters' and Factory Mutual Laboratories, National "99" is an exclusive National development!

ers formed on the membranes. Membranes will be active for producing layers capable of moving in the field of gravity as long as in contact with the unchanged dispersion. Continuous removal of the concentrated and diluted layers during the process, as well as continuous replacement of the colloid already separated, is essential.

There are numerous cases when the resistance of flow of the colloid concentrated and retained by the membrane is too great. This tendency to accumulate on the membrane can be rectified by periodical reversal of the direction of flow of the current. To improve the economy of the process, the distance between the membrane had to be reduced. This was accomplished by introducing as many membranes as practically possible between the electrode cells. In this way, effective area of the membranes could be greatly increased.

Rate of separation is in approximate direct proportion with the area of the membranes. In general, economy of the process depends on the concentration, specific conductance, viscosity of the dispersion, migration velocity, density of the colloid particles. Properties of the concentrated layer formed on the membranes have to be considered.

The process of separation is independent of particle size. Concentration of the enriched layer is limited by the viscosity of the same. A freely flowing layer is essential. Design of a technical unit is very simple. Application of the process has been found already in concentrating rubber latex in Malaya.

Paul Stamberger, Dover, Del., before the Division of Colloid Chemistry, American Chemical Society, Buffalo, N. Y., Sept. 7-11, 1942.

PENNSYLVANIA ANTHRACITE AS A FILTER MEDIUM

PENNSYLVANIA anthracite, being essentially a carbon and hence more nearly chemically inert than other substances used in filters, is well suited for use in many filtration processes. Its conchoidal fraction produces a particle which has the most desirable shape for filter use; its low specific gravity and angular particle shape make possible longer filter runs and more effective bed washing at lower backwash rates. Filter capacities have been increased 25-100 percent through the use of anthracite as a filter medium.

Under the trade name of "Anthrafilt", Pennsylvania anthracite is used in municipal filters, power plant filters for the hot process softening of waters and for oil removal from boiler condensates, swimming pool filters, filters for clarification of chemicals and sew-

• • •

More than a century was consumed in bringing the crude rubber production of the world up to a million tons yearly. The United States has undertaken to accomplish almost as mighty a feat in less than two years by the manufacture of chemical rubbers from petroleum, alcohol, coal and limestone.

By the end of 1943, our production of aluminum will be at a rate almost seven times greater than was attained in 1939 after 50 years of intensive development.

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age. In preparation of Anthrafilt, care is given to the selection of a low-ash material with the optimum particle shape; the most important single factor involved is manufacture of the correct particle size to meet the conditions of the filter use and design.

H. G. Turner, Anthracite Equipment Corp., before the Division of Gas and Fuel Chemistry, American Chemical Society, Buffalo, N. Y., Sept. 7–11, 1942.

NEW USES FOR COAL IN THE CHEMICAL INDUSTRY

LOW-BOILING fractions in by-products from the carbonization of coal have been the almost exclusive source of aromatic compounds for the chemical industry. Recent large demands for benzene, toluene, naphthalene, and phenolic compounds and some of their derived products such as aliphatic and aromatic dicarboxylic acids naturally lead to consideration of other possible sources of these compounds.

Direct degradation of bituminous coal can furnish in good yields any desired range of molecular sizes of carbo- and heterocyclic structures. The more complex are naturally the easier to produce. In the presence of certain solvents at temperatures up to 350 deg., as much as 80 percent of bituminous coal can be converted to ash-free "bitumens", condensed cyclic structures of molecular weight ranging from a few hundred up to perhaps a thousand. Mild oxidation reactions produce the so-called "regenerated humic acids" of similar nuclear structure to the bitumens, but with sufficient peripheral polar groups to give them acid properties, as evidenced by their solubility in alkaline reagents and their ability to form salts.

More drastic degradation of bituminous coals, in the presence of hydrogen, at 400-500 deg. leads to simpler molecular types which are, for the most part, distillable. These are predominantly aromatic hydrocarbons although significant amounts of naphthenes and paraffins are also present. Under certain conditions, an appreciable fraction of the oxygen of the coal may appear as phenolic compounds, and of the nitrogen as organic bases.

Oxidation at elevated pressures and temperatures results in production of simple aliphatic acids such as acetic and oxalic, along with aromatic acids of the benzene carboxylic series, from the phthalics to mellitic, and other polycarboxylic acids of more complex nuclei.

Increasing demands of the synthetic chemical industry for aromatic structures may be met by application of these methods of degradation either directly to bituminous coals or to the complex cyclic structures from coke ovens, the tars and pitches, which for

★ In one of their recent bulletins on hoists, the National Safety Council says:

"Hooks which have become bent on account of overloading should not be straightened and put back in service, but a new hook should be provided. When a hook is once bent the stress in the metal tends to weaken it so that afterward its strength is a matter of doubt and cannot be depended upon."

That's good advice. With the lives of American boys utterly dependent upon our industrial production, this is no time to take chances which may cause lost time accidents to men or machines, or both.

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Don't Abuse Your Hoist. Now that we are all faced with restrictions and shortages proper maintenance is of paramount importance. While every **WRIGHT HOIST** is built with load-carrying factors considerably in excess of their rated capacities, like many other well-made pieces of mechanical equipment built for specific duty, they should not be overloaded. Overloading is dangerous—to men, materials, machinery and steady production. Remember—abuse to machinery today is akin to sabotage. Conserve steel and maintain production schedules by careful use, regular inspection and proper lubrication.

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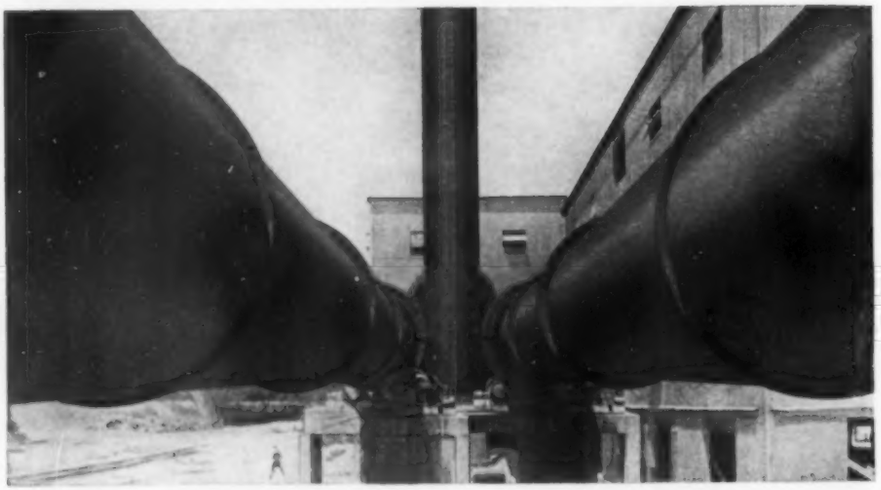

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see bulletin 115

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the most part are now either used for structural purposes or are burned.

H. C. Howard, Carnegie Institute of Technology, before the Division of Gas and Fuel Chemistry, American Chemical Society, Buffalo, N. Y., Sept. 7-11, 1942.

PRESENT STATUS OF PLANT HORMONES

PHENOXY AND benzoic acids substituted in the nucleus with halogen, methyl and nitro groups have opened a new line of attack on plant hormone problems. Phenoxyacetic acid is slightly active for cell elongation but does not induce formative effects of growing plants. When substituted in the ortho and para positions, the resulting dichlorophenoxyacetic acid is very effective, causing cell elongation, adventitious roots, parthenocarpy, and various formative effects. Parachlorophenoxyacetic is less active than the dichloro, and the ortho compound is less active than the para.

Bromo-substituted compounds are slightly less active than the chloro. 2, 4, 6-tribromophenoxyacetic acid is inactive, but 2, 3, 5-tri-iodobenzoic acid is very active. Higher homologs, such as chlorophenoxy-alpha-propionic acid and chlorophenoxy-alpha-butyric acid are active for cell elongation and adventitious roots but not very active for formative effects.

Benzoic acid is physiologically active until substituted with halogen or nitro groups. 2-chloro-5-nitrobenzoic acid is inactive for cell elongation but is active for modifying the pattern of leaves. 2-bromo-3-nitrobenzoic acid is active for both factors. Considering the increased activity of substituted phenoxy and benzoic acids over phenoxy and benzoic acids, it appears that the activity of many other substances in the hormone field might be increased by this method.

Principal practical uses for growth substances to date are to propagate plants from cuttings, prevent preharvest drop of apples, induce seedless fruit (especially tomatoes), and inhibit buds (especially of potato tubers). Flowering of plants can be regulated to some extent with several of the most active compounds. Treatment of seeds with growth substances to increase the crop has not been effective.

P. W. Zimmerman, Boyce Thompson Institute for Plant Research, Inc., Yonkers, N. Y., before the American Chemical Society, Buffalo, N. Y., Sept. 7-11, 1942.

AMERICAN POTASH RESERVES

WORLD WAR II finds the United States with a potash industry well established, with adequate supplies of raw materials, methods of production carefully worked out, plant capacities ample for expected demands, and prices little affected by the disturbed conditions of world trade.

Potash reserves may be grouped into three classes. In the first division belong salts minable under present commercial conditions, and include those now available as sylvite and langbeinite in New Mexico. Brines now un-

der exploitation for K_2O values include only those of Searles Lake, Calif., and those in west central Great Salt Lake desert, Tooele County, Utah. Some cement plants are located sufficiently near sources of potash-bearing silicates to use such materials in their mix and to recover volatilized potash from flue dusts. Several cement companies did this during World War I, but only one, the North American Cement Corporation, Hagerstown, Md., is doing it today. At the present annual consumption rate of approximately 500,000 tons K_2O, these sources as now known could probably supply the country's needs for more than 200 years.

In the second-order reserves may be grouped deposits which give promise of early development in connection with plans for production of aluminum and magnesium. These are concerned with alunite deposits, chiefly in the Marysvale district, Utah, and with carnallite and its associate brines and salts in the Salt Valley anticline, Grand County, Utah. These reserves, especially the carnallite, cannot be estimated from present data, but may be large; their technology is well understood.

Third-order reserves include polyhalite, leucite, greensand, sericite, feldspar and others. The available quantities are enormous, and it is not unreasonable to think that by the time supplies of the first two classes are exhausted, conditions may be ripe for exploitation of those in the third class. In any event, the potash industry in America in the next few years is more likely to be affected by international and domestic social conditions arising from the war than by any lack of suitable raw materials.

George R. Mansfield, U. S. Geological Survey, Washington, D. C., before the American Chemical Society, Buffalo, N. Y., Sept. 7-11, 1942.

DEHYDRATION OF FRUITS AND VEGETABLES

DEHYDRATION of vegetables for the Army, Navy, and Lend-Lease has recently assumed important proportions. According to a recent estimate, the military forces will require about 25,000,000 lb. of dehydrated vegetables in 1942.

Forced draft tunnel dehydrators using trays and controlled temperature are generally used. General quality of the dried products is better than those supplied the A.E.F. in 1917 and 1918, since blanching to inactivate enzyme activity and drying to a very low moisture content give dried products of better keeping quality. New and mysterious dehydration devices and schemes should be viewed with skepticism, as the basic principles and operations are simple and well established. The central air discharge, combination parallel-and-counter-current forced draft dehydrator in use in Canada is very efficient and satisfactory for drying of vegetables.

Vitamin C is largely lost in dehydration and subsequent storage of dehydrated vegetables; in some cases caro-

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tene also is very unstable to oxidation and may be lost. The B vitamins are quite stable during drying and storage. Vegetables should be dried to low moisture content in order to prevent rapid deterioration in storage.

In the dehydration of fruits, undesirable color changes and loss in C and carotene can be minimized by steam blanching, although darkening and loss of these vitamins are more rapid in storage than in the case with the sulphured fruits. However, exposure to burning sulphur fumes is the customary pre-treatment. Dehydrated fruits require less SO_2 for satisfactory color retention than do the sun-dried. Most walnuts and much of the California prune crop are now dehydrated. Most California apricots, peaches, pears, and raisins are still dried in the sun; although in normal years considerable quantities of sulphur-bleached seedless grapes and pitted, peeled, clingstone peaches are dehydrated. Apples, of course, are dehydrated or "evaporated", various types of dryers being used. Inhibition of enzyme action is highly important in the dehydration of vegetables and fruits.

W. V. Cruess, College of Agriculture, University of California, Berkeley, Calif., before the American Chemical Society, Buffalo, N. Y., Sept. 7-11, 1942.

INSECTICIDAL AEROSOLS PRODUCED BY SPRAYING SOLUTIONS IN LIQUEFIED GASES

A NEW METHOD of producing insecticidal aerosols has been developed which promises effective control of malaria and yellow fever mosquitos. The method consists in developing a fog by allowing a solution of insecticide in a liquefied gas to escape into the atmosphere. This disperses the toxic material in such a finely divided form that it remains suspended in the air for long periods, greatly increasing its effectiveness.

Such spray solutions in liquefied gas are now being sold for Army and Navy use in 5-lb. tanks with nozzles attached ready to use. They are also put out in 1-lb. dispensers for household use which cost only a few cents and can be discarded when empty.

The most promising insecticidal aerosol is prepared by allowing a solution of pyrethrum and sesame oil in dichlorodifluoromethane to spray into the air. This is highly toxic to

• • •

Magnesium is about 60 percent the weight of aluminum and about one-fifth the weight of steel. It sold, in 1915, for $5 per lb. Today, measured by cubic feet, magnesium at 22½ cents a lb. is cheaper than aluminum selling at 15 cents a lb. After the war, the Nation's capacity for producing this lightest of all structural metals will be more than double its aluminum output of 1939 and during 1943 we will produce 100 times the amount of magnesium that was produced in 1939, when the magnesium industry in America was 24 years old.

many species of insects, yet non-toxic to man, non-flammable and does not produce oily deposits. One small drop of the active ingredient is sufficient to kill all yellow fever mosquitos in 1,000 cu.ft. of space. It has been shown to be very effective against house-flies, stable flies, wasps, hornets, the cheese skipper adult, ants, and many other insects. At high concentrations, cockroaches can be controlled.

This material has all the requirements of a safe, yet effective insecticide for use on airplanes. It is well adapted and very effective in the control of the mosquito that transmits malaria.

Other insecticides such as nicotine, toxic to man, can be applied with methyl chloride, especially for greenhouse fumigation. Very little apparatus is needed. Since the liquefied gas solution of the insecticide must be in a closed container with a valve, the only additional equipment is a suitable nozzle. At a given temperature the spraying pressure is constant until the contents of the tank are exhausted.

Such aerosols are much more finely divided than the mists produced by most methods of spraying and settle much more slowly. A method of studying and comparing the settling rates of the mists and aerosols has been developed. A blue dye is included in the solution and the settling rates can be quantitatively determined with a photometer.

Other insecticides which can be applied in the same method include nicotine, thiocyanates, rotenone, phenothiazine, p-dichlorobenzene, or any material soluble in some liquefied gas. Other gases besides dichlorodifluoromethane can be used. Even liquid CO_2 has possibilities, but the heavier container which is required is not as convenient.

L. D. Goodhue, U. S. Bureau of Entomology and Plant Quarantine, Beltsville, Md., before the American Chemical Society, Buffalo, N. Y., Sept. 7-11, 1942.

COMPRESSED AIR FOR AMMONIA OXIDATION

AN INTENSIVE development of the ammonia oxidation process for the production of HNO_3 has occurred within the past 15 years. Absorption of the oxides of nitrogen and the production of 60 percent HNO_3 are greatly facilitated by application of moderate pressure. Consequently most nitric is produced from ammonia-compressed air mixtures. A typical process supplies air at a pressure of approximately 9 atm. absolute in order that the absorption system may operate at 8 atm. and the spent gas header at 7 atm.

There are two essential requirements for compressed air for ammonia oxidation: constant pressure and cleanliness. Since the flows of the two gases are usually controlled by orifice meters, it is necessary that the pressure be held constant to insure constant rate of flow. Engine-driven compressors may be controlled within close limits by means of a hydraulic piston-type regulator governing point of cut-off. Electric motor driven compressors operate at

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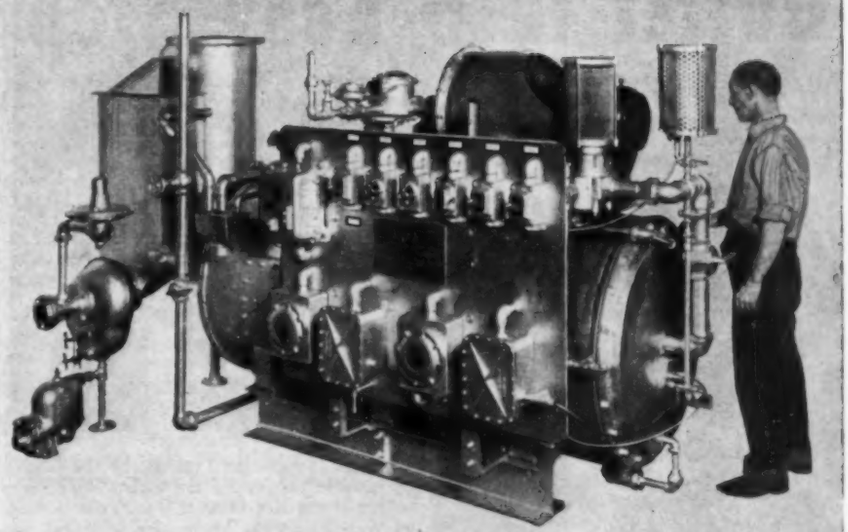

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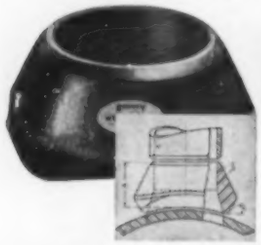

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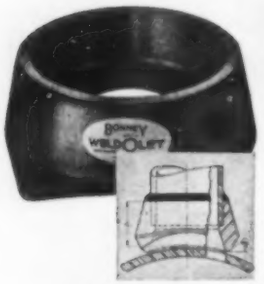

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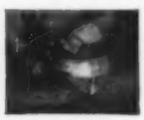
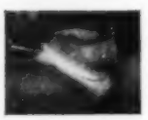
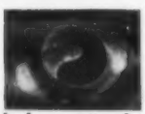


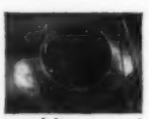
1 Select the position of the outlet. Rub the fitting over the pipe several times at the position of the outlet to remove scale and dirt. Then mark center lines and tack into position.



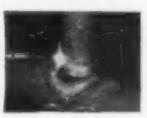
2 Tack in a sufficient number of places to insure its desired position. No clamps are necessary. Then weld, following and filling the bevel along the base of the fitting. A junction of full pipe strength results.



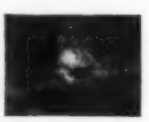
3 Then remove the button with the torch, a hole saw or by drilling. Where the outlet is smaller than 2" . . . or under unusual conditions on the larger sizes, the fitting should be used as a templet and the hole cut in the main pipe first.



4 After the fitting is installed on the main pipe and the button removed, the inside of the joint is in full view for inspection . . . impossible with a junction made in any other way . . . or with any other type of fitting. Icicles, scale and excess welding metal are eliminated. They are removed with the button.



5 The branch pipe is then attached to the outlet of the fitting . . . by welding, if a WeldOlet or Socket-End WeldOlet is used . . . or simply screwed into position if a ThredOlet is used.



6 The job is then complete. Note the trim, mechanical appearance. A leakproof junction of full pipe strength has resulted without the use of templets or complicated forming and fitting.

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constant speed and regulation is usually obtained by an unloading device incorporating clearance pockets in the cylinders. The close range unloader provided for ammonia oxidation service is capable of maintaining pressure control within less than 0.5 percent.

Clean air is essential to avoid contamination of the platinum gauze catalyst. Air intakes are usually fitted with filters to exclude dust, which might also cause excessive cylinder wear. The lubricant used in the cylinders is extremely important as improper lubrication may contaminate the air with oil vapors which cannot be removed by the filters preceding the platinum gauze. Tubular aftercoolers should always be employed to condense oil and water vapors which might otherwise cause fire or freeze-up in air lines.

To produce one ton of HNO_3 per day, approximately 100 cu.ft. per min. of air must be supplied to provide oxygen for the reactions involved plus a suitable excess to maintain favorable oxidation conditions in the absorption tower. Compression of this quantity of air to 9 atm. absolute requires an input of about 20 hp., employing an efficient 2-stage compressor.

Spent gas exhausted from the absorption tower may be collected in a header at about 7 atm. absolute. About 82 cu.ft. of spent gas are obtained per 100 cu.ft. of process air. A large amount of heat is generated by oxidation of the ammonia, and since this must be removed before the reaction products enter the absorption tower, a tubular heat exchanger serves the dual purpose of cooling the converter gas and reheating the spent gas. Substantial power recovery may be obtained by expanding the reheated gas through a suitable engine. This spent gas consists principally of N_2 plus about 3 percent O_2 and a small amount of nitrogen oxides not absorbed in the HNO_3 tower. This will seldom be less than 0.1 percent and may be as high as 0.25 percent when the tower is operated at rates in excess of most efficient capacity.

Ordinary steel construction will satisfactorily withstand spent gas so long as the temperature is maintained above the dew point, but any condensation will speedily attack steel surfaces. For this reason the exhaust temperature of the engine must be kept above 150 deg. F. and the cylinder jacket temperature must be maintained above this point. Hot water at about 200 deg. F. may be circulated by a pump through the cylinder jackets or thermal circulation with evaporative cooling may be employed. Complete adiabatic expansion from 7 atm. to 1 atm. would require an initial temperature of 600 deg. F. in order that a final temperature of 150 deg. F. be obtained. Actually, losses due to incomplete expansion and friction limit the engine efficiency to about 70 percent. An initial temperature of about 450 deg. F. is sufficient.

First attempt at large-scale power recovery was made in 1929 by the Hercules Powder Co. in collaboration with

Ingersoll-Rand Co. The expansion engine was adapted from a standard piston valve steam engine. The practical limit for a reciprocating engine of this type is 550 deg. F. and this temperature was chosen for initial operation. Lubrication difficulties were immediately encountered. The piston valve gear proved entirely unsatisfactory for use under the conditions.

At this point Mr. J. D. Thomas of the Hercules Powder Co. redesigned the valve mechanism, eliminating the sliding internal parts by making the machine operate at fixed cut-off at approximately ⅛ and introducing water cooling of the valve. Some difficulty was experienced with carbonization in the cylinders. "D.T.E. Heavy Engine Oil" was selected as most resistant to decomposition under the conditions. While carbonization of the lubricant increases progressively with increasing gas temperature, there is an apparent critical point at about 505-510 deg. F. above which decomposition is greatly accelerated. It has been found advantageous to limit the inlet temperature to a maximum of about 500 deg. F. The engine is rated at 180 r.p.m. maximum but it is actually operated at 165 r.p.m. Three of these units have been operated continuously (except for maintenance periods) for 13 years at the Hercules Powder Co. at Parlin, N. J. Power recovery has averaged about 40 percent, some 60 percent of the total compressed air being furnished by the steam-driven primary compressors.

A substantial improvement in the design of the power recovery engine resulted from the collaboration of Ingersoll-Rand Co. with Mr. Joseph Segel of the du Pont Co. The inflexible modified piston type valves were replaced by poppet valves similar to automotive design. In these valves, only the valve stems require lubrication. The lubricating oil is introduced at the midpoint of the cylinder which is never uncovered by the piston, consequently oil does not enter the hot gas stream in appreciable quantities.

This unit, known as the "Type XRD Expander" is capable of operating at higher temperatures in order to secure efficiencies of 50 percent, or it may be operated at a longer period between carbon removals at the same temperature conditions as the original unit. Recent inspection of an XRD unit after 7,000,000 revolutions with inlet temperature averaging 475 deg. F. revealed the cylinders to be still fairly clean. Further improvement has been realized by lubrication with a turbine oil of the "extreme-pressure" type, so that it now appears feasible to operate at least 10,000,000 revolutions between shutdowns for inspection and carbon removal. Two 20x20 in. double-acting power cylinders connected to a 2-stage 26-in. and 16x20 in. air compressor deliver approximately 1,900 cu.ft. per min. of processed air operating at 180 r.p.m.

Donald G. Morrow, Hercules Powder Co., Wilmington, Del., before the American Institute of Chemical Engineers, Boston, Mass., May 11-13, 1942.

An Important Message to

Technical Men

The war has carried the engineering age to a new peak! Production demands have created technical problems the like of which the world has never seen before! The services of engineers are at a premium. Especially the services of one particular class—executive engineers—*engineers with business training;* engineers who can "run the show."

In these critical times, the nation needs engineers of executive ability *now, today*—not five, or ten years from now! The shortage of such men is acute—even more acute than that of skilled production workers. And company heads, aware of this situation, are offering high rewards to engineers who have the necessary training in industrial management.

Golden Opportunity for Engineers

In this new era, the engineer with vision and foresight has a golden opportunity. He will realize that out of today's tremendous production battles will emerge technical men who not only will play a major role in winning the war, but who also will be firmly entrenched in key executive positions when peace comes.

However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other divisions of business—of marketing, accounting and finance. He has of necessity a vast amount of technical training and experience. But in order to grasp the opportunities that present themselves today—to assume leadership on the production front—he must *also* have an understanding of practical business principles and methods.

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The Institute's training plan has the endorsement of leading industrialists and business men. And it is only because these high-ranking executives recognize its value and give their cooperation that such a plan is possible. Among those who contribute to the Course are such men as Frederick W. Pickard, Vice President and Director, E. I. DuPont de Nemours & Co.; Thomas J. Watson, President, International Business Machines Corp.; James D. Mooney, President, General Motors Overseas Corp.; Clifton Slusser, Vice President, Goodyear Tire and Rubber Co. and Colby M. Chester, Chairman of the Board, General Foods Corp.

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View showing spring compensated cross head guiding valve stem and connection with valve stem. Thrust adjustment mechanism and thrust indicator.

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. . . has a cross head equipped with compensating springs to assure tight seating regardless of temperature variations. The connecting rod driving the cross head stops on dead center, so that once closed the valve cannot "back-up".

. . . is provided with a handwheel for manual operation that drives thru differential gearing so motor is always engaged. Control is constantly operative, either electrically or manually. Handwheel does not rotate when in motor operation and Motor does not revolve when in manual operation.

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SELECTIONS FROM FOREIGN LITERATURE

CHEMISTRY IN METALLURGY

THE THREE factors in successful manufacture of iron and steel are control of the reduction to metal, advance knowledge of the heat required for reactions, and reaction control in the refining operations. In establishing the heat balance and the physical conditions in the converter it is important to know the properties of the melt and also of the slag. Losses of ore and metal before reaching the converter should also be known. In blast furnace operation losses due to humidity can be calculated with some accuracy. For example if the air blast amounts to 140 cu. m. per min. and carries 16 g. of water vapor per cu. m., the furnace will receive 2.24 kg. of water per min. As this water vapor is activated by dissociation its theoretical corrosive effect is 14.42 kg. of iron oxide per min. This may mean a production loss as high as 20 percent. In actual practice the theoretical corrosive effect is not reached, but excessive humidity increases the loss of iron and slag. Experience indicates that the water vapor content of the air blast should be below 8 g. per cu. m. to avoid disturbance in furnace operation. The heat balance in blast furnace operation also needs attention and with respect to heat input seven factors call for consideration. In operating converters such as the Thomas converter, correct calculation of conditions in advance saves much trouble and expense which would otherwise be required for correction of operating defects.

Digest from "The Role of Chemistry in Metallurgy," by Carlos V. Guillon, *Revista Brasileira de Quimica* **13**, 94-7, 150-3, 1942. (Published in Brazil.)

MOLECULAR DISTILLATION

AMONG the leading applications of molecular distillation is the preparation of vitamin concentrates from fish liver oils. Potentially, however, there are numerous other uses of molecular stills in the technology of high-boiling liquids. For example, raw vegetable oils contain natural antioxidants which protect them from rancidity but the customary refining processes (steam distillation and decolorization) destroy these antioxidants. Hence refined oils are often more sensitive to spoilage than the raw oils. But when such oils are refined by molecular distillation the antioxidants are retained and stability is not sacrificed. Again, in distilling mineral oils a substantial fractionating effect can be achieved by adjusting temperature to obtain maximum differences in evaporation rates. Molecular stills have astonishing capacity if viewed by ordinary standards; a small plant containing 12 evaporating units and 13 condensing units, in a steel vacuum shell measuring 12x24x30 inches, produced 4 tons of distillate per day at an operating pressure of a millionth of a millimeter. To operate in such a manner a molecular still must have constant feed, an efficient degassing system, accurate temperature control at every stage and a system of backing, booster and diffusion pumps to maintain high vacuum throughout the still system.

Digest from "Molecular Distillation," by W. F. Withers, *Australian Chemical Institute Journal and Proceedings* **9**, 103-7, 1942. (Published in Australia.)

METAL AND SALT MELTS

IN RESEARCH on distribution equilibriums between melts of metals and their salts, specifically the influence of bismuth on solubility of cadmium in cadmium chloride, an improved analytical method was needed. Experiments showed that when cadmium is dissolved in nitric acid at a concentration of four equivalents it brings the effective acid concentration considerably below this level before the boiling point is reached. The Volhard chloride determination was satisfactory when modified by adding a small proportion of nitrobenzene and adjusting the concentration to avoid both the nitric acid effect and the nitrous acid effect. If the Volhard titration is made at room temperature the nitric acid concentration may be as high as four equivalents without influencing the chloride concentration. At elevated temperatures titration in acid solution causes significant losses of chloride even at much lower acid concentrations. In following the effect of bismuth on solubility of cadmium in chloride melts the improved Volhard titration involves dissolving the metal in nitric acid in the cold, precipitating the chloride with silver nitrate and then boiling off the nitrous acid. This procedure is expected to yield significant information concerning the behavior of metals in salt melts.

Digest from "Effect of Nitric and Nitrous Acids on the Volhard Method," by J. M. Bingley, *Australian Chemical Institute Journal and Proceedings* **9**, 108-11, 1942. (Published in Australia.)

GAS-FIRED INDUSTRIAL FURNACES

FOR MANY industrial processes, e.g. in carburizing steel and in the salt bath treatment for normalizing aluminum alloys, there is a constant temperature period in which fuel is used only to maintain the specified temperature against heat losses. Efficiency is then a problem of minimizing thermal losses and must be considered in that light when planning the thermal load and designing the equipment. Design must be directed toward high efficiency in reaching the operating temperature and low maintenance demand. A common operating fault which lowers efficiency is an unnecessarily high rate of gas feed. It is important for safety, as well as economy, to ascertain the optimum gas rate and to maintain it against pressure fluctuations by means of control devices. Flue gas analysis does not receive enough attention in

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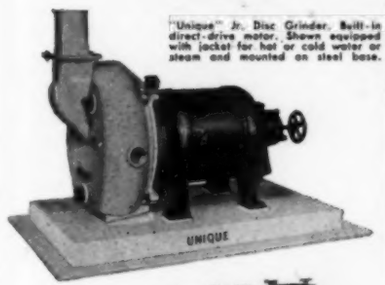

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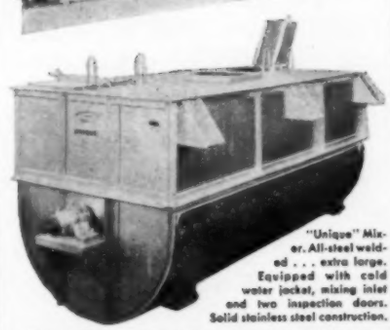

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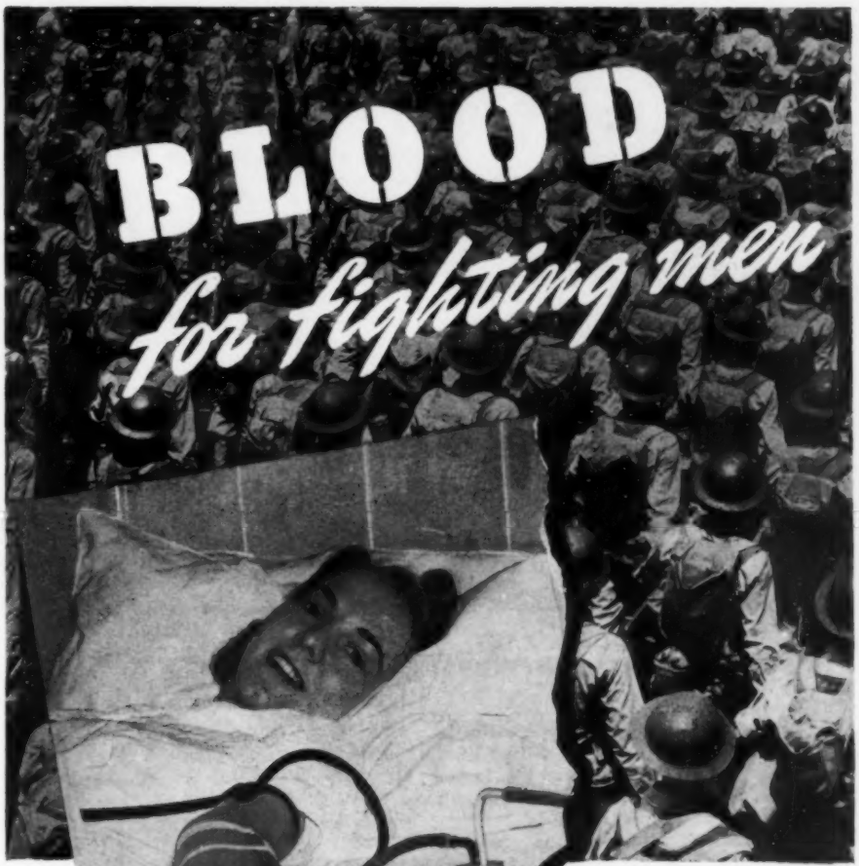

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the control of industrial furnaces, partly because conditions vary too much to permit any fixed standards such as apply to domestic gas burners. It is possible, however, to ascertain the optimum flue gas analysis for given conditions, and this should be part of the basis for planning maximum operating efficiency. The correct length of flue and systematic use of the damper are important factors in furnace efficiency. Thermostats are important not only for process control but also for gas economy. Finally, equipment must be regularly inspected for faults due to corrosion, wear, brickwork failures and other sources of loss.

Digest from "Design and Operation of Gas-Fired Industrial Equipment in Relation to National Fuel Economy," by E. A. C. Chamberlain, *Gas Journal* **238**, 515-9, 1942. (Published in England.)

AUTOMOTIVE GAS PRODUCERS

GAS production for trucks and buses has been improved sufficiently to provide an acceptable solution to one of two main problems, namely reduction of cylinder wear to about the same rate as with gasoline. The usual fuel for a portable gasoline producer is anthracite or a coking coal and improvements which would widen the range of usable fuels are needed. Sulphur is still a problem and research is needed to prevent the sulphur content of coal from passing into the gasoline and thus reaching the engine. A bus has been especially designed to house a gas producer and the Ministry of Transport allows for this purpose an over-all length of 30 ft. although the limit for gasoline buses has been 27 ft. 6 in. The engine in the bus will have standard cylinder heads but with special induction arrangements to suit the mixing valve and with provision for upper-cylinder lubrication. The producer has three horizontal cooling tubes, 6 ft. long with a dust throwout in each tube. The tuyere is water cooled from a 15 gal. tank. It has been demonstrated that vehicles of this kind can help to ease the gasoline situation.

Digest from "Practical Application of Gas producers to Road Transport including Passenger Service Vehicles," by S. G. Ward and W. J. Morison. *Journal of the Institute of Fuel* **15**, 131-46, 171-7, 1942. (Published in England.)

BENZOLE RECOVERY

WHEN benzole recovery from coke-oven tar is carried to a high efficiency, the absorption of carbon disulphide increases thus raising the sulphur content of the crude benzole and lowering its quality. For ordinary purposes the yield of benzole is more important than keeping down the sulphur content. For munitions production toluene recovery is an important factor both in scrubbing and stripping operations. Because of its lower vapor pressure toluene is effectively recovered and the oil circulation rate is adequate for good benzole recovery. Toluene, however, requires much more steam than benzole for separation from the oil by distilla-

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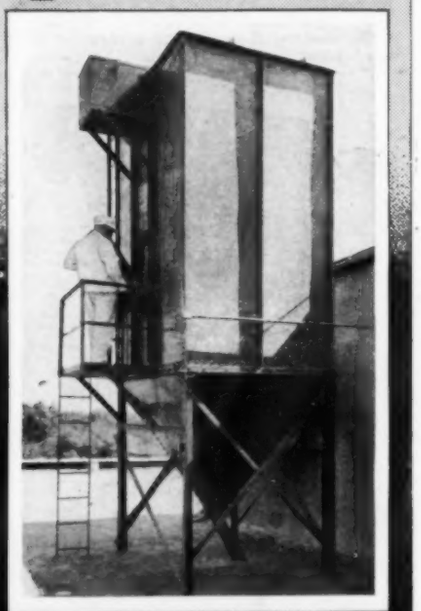

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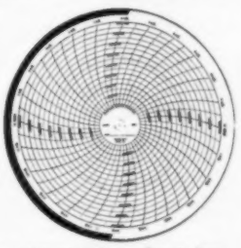

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tion. The amount of steam usually employed is much less than would be required to remove all the toluene from the oil. Ordinarily this deficiency is offset by the rate of oil circulation which is much higher than would be required for toluene absorption. Use of creosote instead of gas oil for benzole recovery calls for special flow conditions since turbulent flow is needed for efficient heat transfer. In the stripping operation it is still advisable to regard 12 deg. C. as the minimum temperature of oil entering the still but higher temperatures may be employed advantageously.

Digest from "Principles and Practice of Benzole Recovery," by G. J. Greenfield, *Journal of the Institute of Fuel*, 15, 164-70, 1942. (Published in England.)

FLASH BACK INSTRUMENTS

For maintaining trouble-free gas service in war industries a reliable flash back instrument is needed. A Swedish instrument invented in 1920 but largely neglected has now been put to work to measure the flash back tendency of gas flames. This flash back burner has been very useful as a guide to proportioning mixed gases especially when gas composition is varied from time to time, for example when carburetted water gas is added only during peak load periods. The flash back tester, which is far superior to the usual fuel testing instruments, is essentially a Bunsen burner with an adjustable primary air inlet having its orifice size indicated on a scale. It can be used in bright daylight and apparently its readings are not affected by atmospheric pressure or temperature. Several check tests per minute can be made if necessary. The instrument is not large or bulky and is quite durable. What it actually measures is the tendency of burning fuel gases toward cone formation and flash back.

Digest from "A Flash Back Instrument," by J. A. Morrison, *Gas Journal* 94, 215-7, 1942. (Published in England.)

SOOT BLOWERS

Forms of fouling on heating surfaces have been studied in relation to the design and operation of soot blowers. Boilers should be designed to permit full utilization of the selected type of soot blower, duly considering effects of furnace walls, boiler tubes, superheater, economizer and air heater surfaces. Modern automatic soot blowers include the Clyde, Ivor, Hopkinson and Babcock electric blowers and the Babcock hydraulic blower. Experience, confirmed by inspection and by evidence from color photographs showing ash adhesions and slag formation, indicates that the sequence of blows should be completed in the minimum time permitted by the prescribed rate of rotation, usually about 1 r.p.m. If the sequence is halted or interrupted the cleaned tubes quickly foul again. A panel controlling 36 blowers now occupies much less space than a panel design and installed in 1937 to con-

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trol 33 blowers. In a typical installation of 20 soot blowers 12 are retractable and 8 are non-retractable.

Digest from "Soot Blowers With Special Reference to Presence of Power and Automatic Operation of Mechanical Blowers," by R. J. Glinn, *Preprint, Institution of Electrical Engineers,* 1942, 16 pp. (Published in England.)

SURFACE DIFFUSION

UNDER certain conditions adsorbed films become mobile and diffuse over the adsorbent. This type of migration in a two-dimensional system is analogous in some respects to tautomerism in chemistry. A major difference is that in surface diffusion the points of unsaturation present a continued array, so that one migration leads to another. These successive migrations lead to macromolecular diffusion of the adsorbed film. For a chemical analogy with tautomerism surface migration should involve atomic attachment to different atoms or radicals, and such a phenomenon is indicated by the evidence when adsorbed hydrogen migrates on a tungsten surface. Two kinds of surface compound, differing in chemical properties, are observed. The difference is especially distinct in the case of the corresponding oxygen surface compounds. Studies of surface mobility should be useful in solving problems of catalysis.

Digest from "Surface Diffusion. II. Theoretical," by R. C. L. Bosworth, *Australian Chemical Institute Journal and Proceedings* 9, 169-78, 1942. (Published in Australia.)

SEPARATION OF FATS

IN THE separation of triglycerides, including natural fats, the relation between saponification number and molecular weight is an inverse proportion as illustrated by the fact that triacetin has a theoretical saponification number of 775 while that of tripalmitin is 208. In applying this relation to industrial problems, with due allowance for the fact that natural fats are never composed of a single pure triglyceride, the calculation is made on the basis of the best available analyses for the fat or oil under consideration. A slight excess of alkali is desirable in determining the saponification number since a slight excess of fat or oil is less convenient to manipulate. Some saponification numbers of fats and waxes are tabulated.

Fat or Wax	*Saponification Number*
Brazil nut oil	178-194
Oiticica oil	185-189
Sesame oil	187-193
Soy bean oil	182-194
Whale oil	160-202
Crude beeswax	88-106
Sun-bleached beeswax	90-98
Chemically bleached beeswax	93-108
Pressed beeswax	81
Solvent-extracted beeswax	64-102
Crude beeswax (India)	75-145
Insect wax	63-93
Carnauba wax	79-95
Lanolin	77-46
Spermaceti	116-135

Digest from "Saponification and the Koetesttorfer Number," by Milton E. Buehrer, *Revista Brasileira de Quimica* 13, 83-84, 1942. (Published in Brazil.)

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INDUSTRIAL CHEMISTRY. Fourth edition. By *Emil Raymond Riegel.* Published by Reinhold Publishing Corp., New York, N. Y. 861 pages. Price $5.50.

Reviewed by *J. R. Callaham*

COMPLETED only three months ago, this fourth edition of Riegel's well-known work on the fundamentals of the chemical and process industries is remarkably complete and up to date. The wordage on each page has been slightly increased, so that although this edition contains the same number of pages as that of 1937, there is actually the equivalent of 75 additional pages. There are also a number of new flowsheets and drawings. The latest production figures, quite often those for 1941, are included and Dr. Riegel again shows, as usual, his keen appreciation of economic factors in industrial processes.

As a concise, handy, reliable, down-to-earth reference book, this work has no equal in the English language. Although the text is necessarily highly condensed, the author has managed to mention a surprising number of the more important recent developments. His brief references on application of metallic sodium in valve stems of airplane motors, fluid catalysts in petroleum refining, the Watson towerless sulphuric acid plant, Foamglas insulating material, geochemical methods of petroleum exploration, oxalic acid from starch, hydroforming as a source of toluene, Pidgeon and Hansgirg magnesium processes, all tend to show how closely he keeps in touch with industrial developments.

Chapters either rewritten entirely or revised to include new material or to shift emphasis among various processes include those on synthetic textile fibers, paper and pulp, rubber and synthetic substitutes, portland cement, petroleum refining technology, manufacture and application of dyes, fuels, pig iron and steel, and others.

Besides its use as a textbook in colleges, this work is almost an indispensable reference in industrial plants and laboratories, technical libraries, and especially for executives, engineers and chemists who need ready access to outstanding developments in the broad chemical fields.

MICROCHEMICAL ANALYSIS

INTRODUCTION TO THE MICRO-TECHNIQUE OF INORGANIC ANALYSIS. By *A. A. Benedetti-Pichler.* Published by John Wiley & Sons, New York, N. Y. 302 pages. Price $3.50.

ONE of the country's outstanding authorities on microchemical methods presents a new textbook to supplant his earlier volume which was concerned only with qualitative analysis. The new book begins with a brief discussion of apparatus for general use and introduces the student to the microscope and accessory equipment. The main part of the discussion is divided into sections on qualitative and quantitative analysis. Centigram, milligram and gamma procedures are included in each. Directions are all given in considerable detail and the exercises progress from elementary to advanced work. Commercial and industrial laboratories may well find that the methods described are applicable to their analytical problems.

MATERIALS TEXTBOOK

CHEMISTRY OF ENGINEERING MATERIALS. Fourth edition. By *R. B. Leighou.* Edited by *J. C. Warner.* Published by McGraw-Hill Book Co., New York, N. Y. 645 pages. Price $4.50.

DURING the eleven years since this standard reference was last revised there have been many important changes in the engineering materials picture. Synthetic rubbers, plastics and the light metals have assumed increased importance; the mechanism of corrosion is better understood; there have been numerous advances in petroleum refinery technology. These and other modernizations of theory and practice necessitated revision of the late Professor Leighou's book if it was to continue as a standard textbook for engineering students and as a convenient reference for practicing engineers.

In addition to modernization of data on synthetic rubber and other subjects mentioned above, there have been included important discussions on water treatment for steam generation, combustion reactions, abrasives, glass, adhesives, and organic coatings. Metals and alloys supply the material for half of the text and important revisions may be noted in discussions of phase rule and equilibrium diagrams, steelmaking, heat treating, corrosion, and metallic coatings.

The task of rewriting, expanding important subjects and condensing some that today are less significant, was divided among seven members of the faculty of Carnegie Institute of Technology. Since no one individual could truly be called an expert in all the fields which this book covers, it gains in authoritativeness by this symposium approach to the revision problem. It will fulfill the purposes for which it was intended.

HIGH TEMPERATURE MATERIALS

REFRACTORIES. Second edition. By *F. H. Norton.* Published by McGraw-Hill Book Co., New York, N. Y. 798 pages. Price $7.50.

NEW material available since the previous edition has resulted in the addition of 200 pages to this reference volume on refractory materials. In addition to additional data on clays, slips and reactions during firing, there are a number of new chapters which will be found helpful in the selection and use of refractories. Style of presentation remains the same (see *Chem. & Met.*, Mar. 1932, p. 157). An introductory section covers statistics, literature and history of the industry. It also includes a long new chapter of background material on fundamental concepts of matter. The major portion of the book is divided into three sections: Manufacturing, Properties, and Use. In the last section, which will probably be of greatest interest to those in the process industries, there are five chapters which cover refractories in the iron and steel industry, non-ferrous industry, power generation, miscellaneous industries, and brickwork construction.

PHYSICAL CHEMISTRY

ACID—BASE CATALYSIS. By *R. P. Bell.* Published by Oxford University Press, New York, N. Y. 211 pages. Price $3.50.

Reviewed by *F. C. Nachod*

THIS book is a brilliant summary and compilation of the manifold variety of reactions where acids and bases function as catalysts. Dr. Bell has had the good fortune to spend several years in Brönsted's laboratory. Thus being at "the very source" these years, as he himself states, determined his interest in the subject and formed the basis for this work.

From a discussion of the historical development, the classical theory of catalysis showing the views of Berzelius, Guldberg and Waage, Ostwald, Wilhelms van't Hoff and others, the reader is lead to the Arrhenius theory. In logical development follows the Debye-Hückel-Onsager theory, and 24 pages are devoted to salt effects. The new concept of acids and bases in terms of proton donors and acceptors, a development largely due to Brönsted's work, is then introduced. It is shown that characteristic reactions, such as neutralization, hydrolysis and so forth can easily be understood from the concept of corresponding acids and bases. General acid and base catalysis, catalytic power, acid-base strength, and catalysis in nonaqueous solutions form the subject of the next chapters.

The reviewer liked the last two chapters best where the author deals with the mechanism of acid-base catalysis and with theories of chemical kinetics. Here, the various experiments dealing with deutero-kinetics are well presented and nonclassical proton trans-

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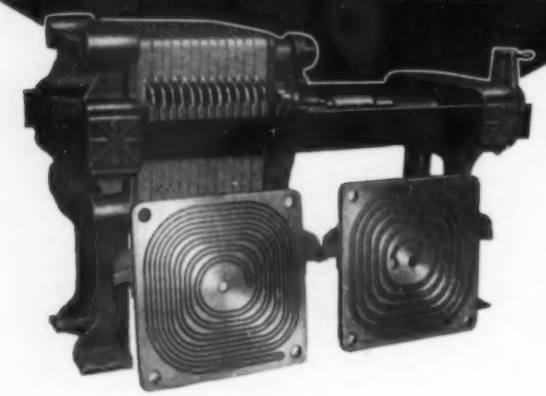

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In clear language and critical form, Dr. Bell offers us a mature and valuable new book which should be required reading for every modern physical chemist.

NATURAL AND SYNTHETIC HIGH POLYMERS. By *Kurt H. Meyer.* Published by Interscience Publishers, New York, N. Y. 690 pages. Price $11.

VOLUME IV of the High Polymers Monographs, written by a professor of organic chemistry at the University of Geneva, is subtitled as a textbook and reference book for chemists and biologists. It is an attempt "made for the first time to give a systematic account of the entire field of natural and synthetic, inorganic and organic high polymers." This ambitious undertaking appears to be largely successful. It certainly is all inclusive. The discussions range from polymerized sulphur and other inorganics through hydrocarbons, cellulose, starch, and proteins to animal and plant tissues. On the whole, it is a scholarly approach to subjects from which we expect, like nylon, many industrially important developments.

ORGANIC REAGENTS IN INORGANIC ANALYSIS. By *Paul von Stein.* Published by Chemical Publishing Co., Brooklyn, N. Y. 242 pages. Price $4.50.

ANALYSTS depend to a large extent on organic reagents for qualitative and quantitative analyses as well as for routine and control work. And when investigating or seeking a new procedure they will find this small book a good starting point. The inorganic elements listed are each given one chapter with the reagents having one paragraph. The directions given usually include preparation of reagent, its use, sensitivity and interferences. In most cases there is included a reference to the original literature and it will occasionally be found that this must be consulted for some further detail such as concentration.

RECENT BOOKS and PAMPHLETS

Facts & Figures on War Finance. Published by The Tax Foundation, New York, N. Y. 37 pages. A booklet of charts and tables presenting data on national income and expenditures, federal taxes, expenditures and debt, corporation income, war bond sales and cost-of-living index. The study shows that to put the nation on a sound fiscal basis and to act as a safeguard against inflation, the American people must pay a much greater proportion of war costs out of current income. At least $10 billion of taxes is needed.

Heat Transfer. Research Publication, Vol. 2, No. 3, Illinois Institute of Technology, Chicago, Ill. 100 pages. A reprinting of six articles (four from

Trans. A. I. Ch. E.) based on work done at the Institute.

Handbook of Industrial Safety Standards. 1942 edition. Published by National Conservation Bureau, New York, N. Y. 224 pages. Price 55 cents. Revised to include most recent accident-prevention standards. A 32-p. supplement covers wartime protection of industrial plants.

The Decolorizing Clays and their Activation, Technology, Analyses and Applications. By *Yvonne E. Stourdze.* Published by the Department of Labor, Industry and Commerce, National Institute of Technology, Rio de Janeiro, 99 pages. This bulletin is divided into a number of short chapters on the preparation of activated clays and their application in decolorizing mineral, vegetable and animal oils. There are data on the absorptive qualities of the clays for various oils, the importance of agitation, size of clay particles, acidity, etc.

The Development of a Technique for the Determination of Tungsten in its Minerals. By *Antonietta de Larmo Canticao.* Published by the Department of Labour, Industry, and Commerce, National Institute of Technology. Rio de Janeiro. 9 pages. The process in question is described in detail but briefly.

A Grease from the Coast of Piaui. By *Camilla Rolin.* Published by the Department of Labour, Industry and Commerce, National Institute of Technology. Rio de Janeiro. 12 pages. A study of a wax-like vegetable grease which may be used in the manufacture of soap and in other industries. Includes a brief discussion on its properties, such as solubility, density, melting point, etc., as well as its analysis, application and origin.

Materials Testing and Heat Treating. By *W. A. Clark* and *B. Plehn.* Published by Harper & Brothers, New York, N. Y. 132 pages. Price $1.75. Another in the Rochester Technical Series of elementary textbooks. Part I, Materials Testing, comprises 35 exercises and Part II, Heat Treating, has nine.

Procedure Handbook of Arc Welding Design and Practice. Seventh edition. Published by Lincoln Electric Co., Cleveland, Ohio. 1267 pages. Price $1.50. An increase of nearly 14 percent over the previous edition is noted in this revision which continues to provide up-to-date information for all concerned with arc welding.

Welding Handbook. 1942 edition. Published by American Welding Society, New York, N. Y. 1593 pages. Price $6. ($5 to A. W. S. members.) Second edition. Covers fundamentals of welding, processes, metals, training, design and applications. All chapters written by outstanding authorities.

Solvent Extraction of Cottonseed Oil. By *W. D. Harris.* Bulletin 63, Engineering Experiment Station, A. & M. College of Texas, College Station, Texas. 31 pages. A brief review of oil extraction processes and a study of methods and economics of solvent extraction.

Proceedings of the Eighteenth Annual Convention of National Fertilizer Association. Published by the Association, Washington, D. C. 114 pages. Papers and addresses presented at the annual N.F.A. meeting last June.

Applied Chemistry Reports, Vol. XXVI. Published by the Society of Chemical Industry, London. 545 pages. A review of technological and scientific advances made during 1941.

Producing for Victory. Published by the Congress of Industrial Organizations. Washington, D. C. 54 pages. Price 15 cents. Suggestions for the formation and functioning of a labor-management committee to study and devise ways to improve efficiency of production.

Supplementary National Emergency Steels NE 9400, 9500 and 9600 Series. Published by American Iron and Steel Institute, New York, N. Y. 89 pages. Results of tests on compositions selected in an attempt to provide an alternate steel for all the standard constructional alloy steels.

Arithmetic of Pharmacy. Seventh edition. By *C. H. Stocking, E. L. Cataline* and *A. B. Stevens.* Published by D. Van Nostrand Co., New York, N. Y. 163 pages. Price $2. Textbook.

Water Handbook. Published by W. H. & L. D. Betz, Philadelphia, Pa. 64 pages. Price 50 cents. First of this

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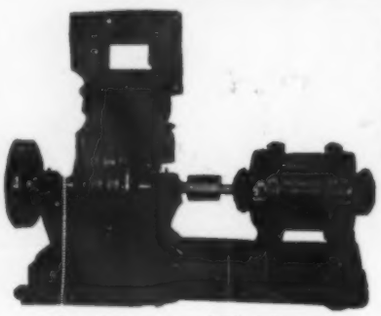

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book's two sections covers water analyses, giving 25 different methods with discussion of results. Second part of the book gives interpretations of tests and their application to plant control. Charts and tables are used to clarify and augment the text of the book which will be welcomed by all concerned with industrial and municipal waters.

Separation by Centrifugal Force. By *A. Ayres.* Published by the Sharples Corp., Philadelphia, Pa. 10 pages. Gratis. A brief but complete discussion of centrifugals. Covers theory, functioning of bowls, design, installation and operation.

Prevent Off-The-Job Accidents. Published by National Conservation Bureau, New York, N. Y. 20 pages. Price $2.50 per hundred. Written and published for distribution to employees as a means of helping to educate them in the need of commonsense care after they have left the protections which surround them at their jobs.

Manual for Committees of Engineers Interested in Engineering Education and the Engineering Profession. Prepared and issued by Engineers' Council for Professional Development, New York, N. Y. 15 pages. Price 10 cents. An aid to engineers and committees acting in an advisory capacity to high school students considering engineering as a vocation. A separately bound Appendix (5c) is addressed to the student as a prospective engineer.

Textile Fiber Atlas. By *W. von Bergen* and *W. Krauss.* Published by American Wool Handbook Co., New York, N. Y. 66 pages. Price $3. A presentation of a set of photomicrographs of all important textile fibers. Includes 31 pages of descriptive and explanatory material pointing out microscopic differences and characteristics for purposes of identification. A bibliography lists many references for further study. Photomicrographs are of large size and are reproduced on a good grade of paper making the atlas a valuable new tool for all who are concerned with fibers and their identification.

New Principles in Heating Koppers-Becker Coke Ovens. By *W. C. Rueckel.* Published by the Koppers Co., Pittsburgh, Pa. 32 pages. Description of new coke oven design which resulted in improved coke quality and permitted more efficient economics of oven operation by a simplification of operating technique. Advantages of the new system are explained in some detail.

Handbook, Butane-Propane Gases. Third edition. Arranged and edited by *Arthur Rohman* and *J. M. Krappe.* 342 pages. Price $5. Production, transportation and storage, distribution, utilization, and regulations are the headings of the main parts of this book prepared for consumers, distributors, dealers and others interested in liquefied petroleum gases. Also included are introductory chapters giving a history of the LP gas industry and physical and chemical properties. An appendix contains tables for field use, bibliography, glossary of terms and index.

Technical Association Papers. Twenty-fifth series—1942. Edited by *R. G. Macdonald* and *V. P. Waters.* Published by the Technical Association of the Pulp and Paper Industry. 836 pages. This is the annual volume of addresses and papers of the February meeting of TAPPI.

Papermaking Abstracts. Compiled by TAPPI Committee on Abstracts and Bibliography. Published by Technical Association of the Pulp and Paper Industry, New York, N. Y. Volume 1, Part 2, pages 149-270. Abstracts of pulp- and papermaking literature, published throughout the world. With Part 1, the abstracts are brought up to the first part of 1942.

Code of Minimum Requirements for Welding Operators. Published by American Welding Society, New York, N. Y. 68 pages. Price 50 cents. A tentative code which is a revision of the 1941 "proposed code." Covers arc welding of steel 3/16 to ¾-in. thick.

Breaking the Skilled Labor Bottleneck. By *E. J. Benge.* Published by National Foremen's Institute, Deep River, Conn. Price $2.50. Contains text, with tables and charts, to help with such problems as training green hands, utilizing present labor resources to greatest advantage, work allocation to spare highly trained men, upgrading, and other factors in maintaining speed with accuracy.

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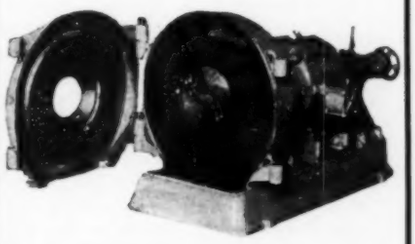
GOVERNMENT PUBLICATIONS

First of a series of orders cutting down government publications and mailing lists was issued Sept. 25. The order, OWI Regulation Number Three, affects 523 Federal publications and series of publications. It makes mandatory for the duration of the war the recent elimination of 239 items and the curtailment of 284. The regulation also provides machinery to make further cuts. The listing below, compiled from the Regulation, gives the changes ordered on publications of possible interest to Chem. & Met. *readers.*

Department of Agriculture	
Office of Information	
Annual Report of the Director	Pages cut from 34 to 17
Journal of Agricultural Research	Pages cut from 192 to 96
Yearbook of Agriculture	Discontinued
Bureau of Agricultural Chemistry and Engineering	
Monthly News Letter	Discontinued
Naval Stores Report	Distribution cut from 5,000 to 2,000
Annual Report of Chief of Bureau	Number of pages cut one-half
Bureau of Entomology and Plant Quarantine	
B of E and P Q News Letter	Discontinued
Insect Pest Survey Bulletin	Discontinued
Entomology Current Literature	Discontinued
Bureau of Agricultural Economics	
Soy Bean Price and Movement	Discontinued
The Fats and Oils Situation	Distribution cut by 365
Peanut Stocks and Processing	Pages cut from 2 to 1
Division Annual Reports	Discontinued
Office of Experiment Stations	
Report on the Agricultural Experiment Stations	Pages cut from 272 to 164; distribution cut by 200
Department of Commerce	
Division of Current Information	
News releases pertaining to foreign trade of United States	Distribution cut from 4,500 to 100
News releases pertaining to domestic economy of United States	Discontinued
World Economic Notes	Reduced from 6 to 3 issues each week
Bureau of Foreign and domestic Commerce	
Monthly Industrial Survey	Distribution cut from 3,800 to 1,600
Industrial Reference Service:	*Distribution Cuts:*
Part 1. Chemicals and Allied Products	From 956 to 50
Part 2. Electrical Products	From 696 to 50
Part 3. Foodstuffs	From 1,254 to 100
Part 4. Forest Products	From 919 to 50
Part 5. Leather and Its Products	From 757 to 50
Part 6. Machinery and Equipment	From 708 to 50
Part 7. Metals and Minerals	From 846 to 50
Part 10. Rubber and Its Products	From 892 to 100
Part 11. Stone, Clay and Glass Products	From 626 to 50
Part 12. Textiles and Related Products	From 815 to 50
Part 14. Special Products	From 663 to 100
National Bureau of Standards	
Bulletin on Current Hydraulic Laboratory Research	Discontinued
Census Bureau	
Paint, Varnish, Lacquer and Fillers	From 1,523 to 674
Linseed Oil: Production and Stocks	Discontinued
Fats and Oils: Animal and Vegetable Factory consumption of primary fats oils by classes or products	Discontinued
Federal Trade Commission	
Press Releases of Commission	From 2,500 to 800
Annual Report	From 5,000 to 3,500
Department of Interior	
Geological Survey	
"Publications issued in (specified month)"	Pages cut from 8 to 3; distribution from 8,500 to 5,000
Bituminous Coal Division	
Weekly Coal Report	From 2,372 to 1,659
Chapter on bituminous coal for Minerals Yearbook	Discontinued
Bureau of Mines	
Mineral Trade Notes	From 2,350 to 150
International Coal Trade	From 1,100 to 100
International Petroleum Trade	From 1,250 to 100
Crude Refinery Report	From 4,035 to 100
Manganese Report	Discontinued
Mercury Report	Discontinued
Slab Zinc Report	Discontinued
Copper Report	Discontinued
Zinc Report	Discontinued
Molybdenum Report	Discontinued
Lead Report	Discontinued
Foreign Minerals Quarterly	Discontinued
Petroleum refineries including cracking plants in U. S.	Discontinued
Department of Labor	
Employment and Payrolls	Discontinued
Earnings and Hours (Monthly)	Discontinued
Earnings and Hours (Annual)	Discontinued
Retail Prices (Monthly, printed)	Discontinued
Retail Prices (Monthly, mimeographed)	From 115,800 to 70,000
Wholesale Prices (Weekly, mimeo.)	From 49,700 to 27,700
Wholesale Prices (Monthly, printed)	Discontinued
Building Construction	Discontinued
Tariff Commission	
Annual Reports	Discontinued
Economic surveys of commodities	Discontinued
Department of the Treasury	
Statistics on Domestic Alcohol	Discontinued
Doing Business with the Procurement Division	Discontinued

New Problems Require New Solutions



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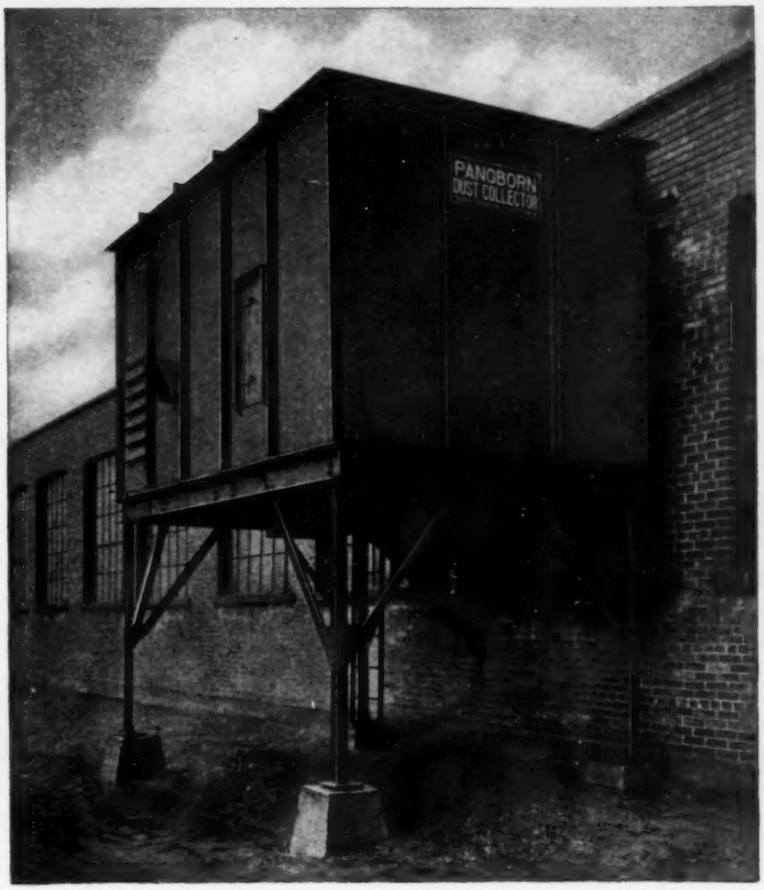

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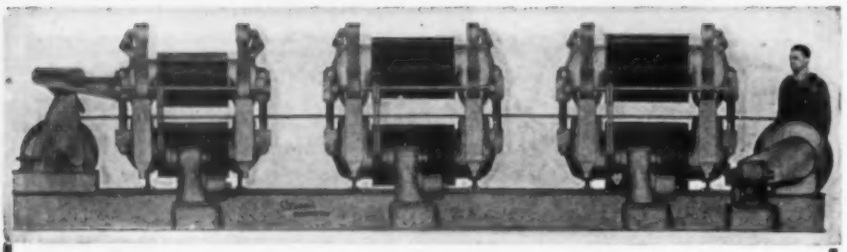

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For separation, concentration, reclamation, purification or protection, engineers and metallurgists every where are depending on Stearns magnetic equipment for efficient, automatic, economical results.

With our many years of pioneering experience in profitably applying the principles of magnetic separation methods to various phases of mining, processing and industrial operations, we are in position to solve your problems.

The Stearns extensive laboratory facilities, with an experienced metallurgist in charge, are available for tests, analysis and recommendation as how best to utilize magnetic separation methods on your material. Make use of this service.

Write for our new Bulletin No. 81 and our questionnaire for laboratory tests of material. Investigate Stearns Megnetic methods. Consult magnetic headquarters.

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The following recently issued documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. In ordering publications noted in this list, always give complete title and the issuing office. Remittances should be made by postal money order, express order, coupons, or check. Do not send postage stamps. All publications are in paper cover unless otherwise specified. When no price is indicated, pamphlet is free and should be ordered from Bureau responsible for its issue.

Limits of Inflammability and Ignition Temperature of Ethyl Mercaptan in Air, by G. W. Jones, R. E. Kennedy, and W. E. Miller. Bureau of Mines, Report of Investigations 3648. Mimeographed.

Variations in Oxygen Condition Between Individual Cartridges and Between Cases of Permissible Explosives, by A. P. Rowles, with A. R. T. Denues. Bureau of Mines, Report of Investigations 3621. Mimeographed.

Questions and Answers on Storage of Coal in the Rocky Mountain Area, by V. F. Parry. Bureau of Mines, Information Circular 7214. Mimeographed.

Use of Subaudible Noises for the Prediction of Rock-Bursts, Part II, by Leonard Obert and Wilbur Duvall. Bureau of Mines, Report of Investigations 3654. Mimeographed.

Industrial Quality of Public Water Supplies in Georgia, 1940, by William L. Lamar. Geological Survey, Water-Supply Paper 912. Price, 15 cents.

Do Grades of Cotton Reflect Cellulose Deterioration?, by Carl M. Conrad and James H. Kettering. Bureau of Plant Industry. Mimeographed.

A Practical Seed-Cotton Moisture Tester for Use at Gins, by George E. Gaus, Charles S. Shaw, and Waldo H. Kliever. Department of Agriculture, Circular No. 621. Price, 10 cents.

The Mineral Composition of Crops with Particular Reference to the Soils in Which They Were Grown, by Kenneth C. Beeson. Department of Agriculture, Miscellaneous Publication No. 369. Price, 20 cents.

Concentration of Wad Ore from the Ayedalotte Property, Batesville, Arkansas, by S. M. Shelton, M. M. Fine, and R. B. Fisher, No. 17 of Manganese Investigations. Bureau of Mines, Report of Investigations 3652. Mimeographed.

Theoretical Calculations for Explosives. II. Explosion Pressures, by F. W. Brown. Bureau of Mines, Technical Paper 643. Price, 10 cents.

Typical Analyses of Coals of the United States, by A. C. Fieldner, W. E. Rice, and H. E. Moran. Bureau of Mines, Bulletin 446. Price, 10 cents.

Gypsum, by Forrest T. Moyer, Bureau of Mines, Chapter (preprint) from Minerals Yearbook 1941. Price, 5 cents.

Potash, by J. H. Hedges. Bureau of Mines, Chapter (preprint) from Minerals Yearbook 1941. Price, 5 cents.

Cobalt, by H. W. Davis. Bureau of Mines, Chapter (preprint) from Minerals Yearbook 1941. Price, 5 cents.

Minor Nonmetals, by Paul M. Tyler and Charles L. Harness. Bureau of Mines, Chapter (preprint) from Minerals Yearbook 1941. Price, 5 cents.

Peat, by Joseph A. Corgan. Bureau of Mines, Chapter (preprint) from Minerals Yearbook 1941. Price, 5 cents.

Control of Welding Hazards in Defense Industries. Division of Labor Standards, Special Bulletin No. 5. Price, 10 cents.

Suggested Standards for Industrial Safeguards. Division of Labor Standards, Special Bulletin No. 7. Price, 65 cents.

Safety for the Worker. Education Office, Vocational Division, Defense Training Leaflet No. 1. Price, 5 cents. This pamphlet has been prepared to acquaint trainees in defense training classes with some basic safety principles and practices that every worker should know.

Military Chemistry and Chemical Agents. War Department, Technical Manual TM 3-215. Price, 25 cents.

Chemical Decontamination Materials and Equipment. War Department, Tech-

nical Manual TM 3-220. Price, 10 cents.

Report of United States Vegetable Oil Mission to Brazil, March 9 to April 28 1942. Inter-American Development Commission. Mimeographed.

Preliminary Report on Synthetic Organic Chemicals, United States Production and Sales, 1941. United States Tariff Commission. Mimeographed.

The Rubber Situation. Baruch Committee Report to the President. House Document No. 836. Price, 10 cents.

List of Commercial Standards. Bureau of Standards, Letter Circular LC695 Mimeographed.

List of Simplified Practice Recommendations. Bureau of Standards, Letter Circular LC697. Mimeographed.

War Facts. Office for Emergency Management. Mimeographed. A handbook for speakers on war production.

Uniform System of Accounts for Carriers by Water Prescribed by Interstate Commerce Commission in Accordance with Section 313 of Part 3 of Interstate Commerce Act. Interstate Commerce Commission. Price, 20 cents.

Power Equipment and Energy Consumption. Sixteenth Census of United States, 1940, Manufactures, 1939. Census Bureau. Price, 15 cents.

Priorities. A review of priority actions issued up to the announced date, published twice monthly by field Service Section, Division of Priorities, War Production Board. Those having urgent need for this type of general review material will be placed on the proper mailing list on specific request to the office indicated. In making such request, the reason for the need should be stated clearly.

Emergency Federal Specifications. The Procurement Division of the Treasury Department has recently announced a series of paint specifications, available in mimeographed form from the Federal Catalog Division, Procurement Division Building. The Procurement Division also announces an emergency specification for steel drums, Type 5 (For Inflammable or Poisonous Liquids); the number is E-RR-D-726a.

Magnesium-Bearing Minerals in the Boulder Dam Area for the Production of Magnesium Metal, by J. Schlocker. Bureau of Mines, Information Circular 7216. Mimeographed.

Bidder's Reference Book, Standard Instructions to Bidders and Contractual Provisions for Use With Quartermaster Corps Negotiated Contracts. War Department, Q. M. C. Form 304. Price, 15 cents.

Plant-Growth Regulators. Agriculture Department, Miscellaneous Publication 496. Price, 20 cents.

Occurrences of Molybdenum Minerals in Alaska, by Philip S. Smith. Geological Survey, Bulletin 926-C. Price, 15 cents.

Tin and Tungsten Deposits at Silver Hill, Spokane County, Washington, by Lincoln R. Page. Geological Survey, Bulletin 931-H. Price, 30 cents.

Chrome Resources of Cuba, by T. P. Thayer. Geological Survey, Bulletin 935-A. Price, $1.00.

Manganese Deposits of Cuba, by Charles F. Park, Jr. Geological Survey, Bulletin 935-B. Price, 10 cents.

Tungsten Deposits of the Nightingale District, Pershing County, Nevada, by Ward C. Smith and Philip W. Guild. Geological Survey, Bulletin 936-B. Price, 40 cents.

Topaz Deposits Near the Brewer Mine, Chesterfield County, South Carolina, by Carl Fries, Jr. Geological Survey, Bulletin 936-C. Price, 30 cents.

Chromite and Quicksilver Deposits of the Del Puerto Area, Stanislaus County, California, by H. E. Hawkes, Jr., F. G. Wells, and D. P. Wheeler, Jr. Geological Survey, Bulletin 936-D. Price, 30 cents.

Manganese Deposits of Cedar Creek Valley, Frederick and Shenandoah Counties, Virginia, by Watson H. Monroe. Geological Survey, Bulletin 936-E. Price, 35 cents.

Laboratory Experiments on Sulfur Dioxide-Sulfuric Acid Leaching of Black and Brown Manganiferous Iron Ores of the Cuyuna Range of Minnesota. No. 14 of Hydrometallurgical Studies of Manganese Ores, by C. Travis Anderson. Bureau of Mines, Report of Investigations 3649. Mimeographed.

WHAT LIES OVER THE HORIZON?

NO ONE has an exact picture of what is in the future for our country. We all know, though, that those who are looking forward now, are those who in our post war economy, will be prepared to help our nation affect the transition that is to be.

Furfural

is now an essential war chemical, and it is unlikely that any large, new, non-essential uses will be allowed for the duration. War Production Board General Preference Order M-224, however, makes specific allowance for purchasing sufficient quantities of Furfural to carry on research. Join now with those who are insuring a place for themselves in the post war period.

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FURFURYL ALCOHOL

TETRAHYDROFURFURYL ALCOHOL

HYDROFURAMIDE

TYPICAL PROPERTIES

Boiling point	157-167°C. (99%)
Freezing point	—37°C.
Flash point (open cup)	56°C.
Refractive index (20/D)	1.5261
Specific gravity (20/20)	1.159

Inquire about Furfural. Learn about its use in tremendous quantities as a solvent and resin reactment. Learn also about the myraid of other uses of this versatile aldehyde.

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TECHNICAL DIVISION 5-10

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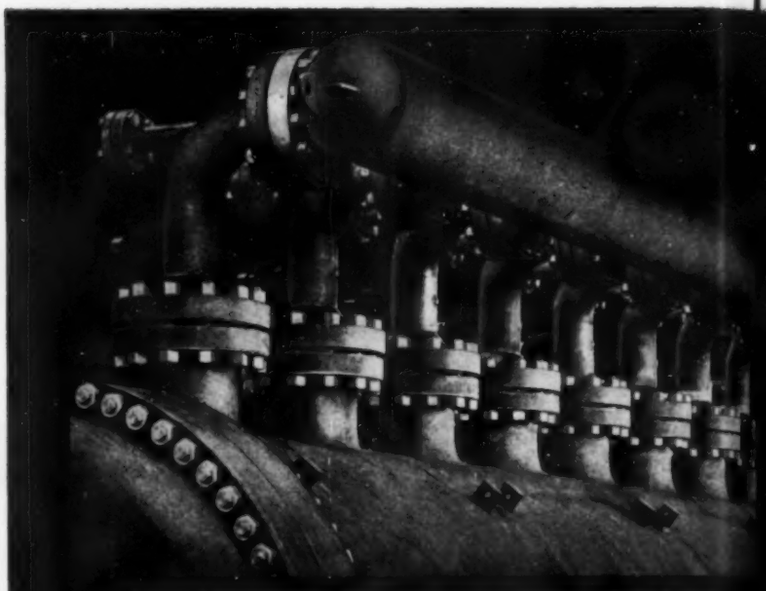
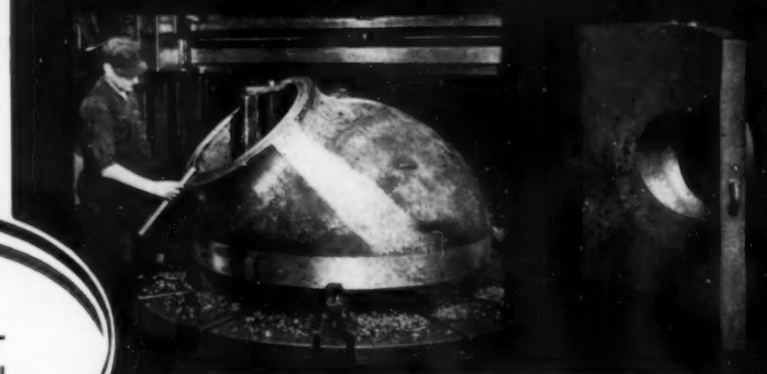
Consult B&W on all High-Temperature High-Pressure Problems



VESSELS FOR HIGH TEMPERATURE SERVICE
Illustration shows vessel with streamlined openings built of Croloy 2 plate for normal service at 100 lb. per sq. in. and 1050 F.



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All reinforcing forged and drawn from parent metal.

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B&W EQUIPMENT INCLUDES

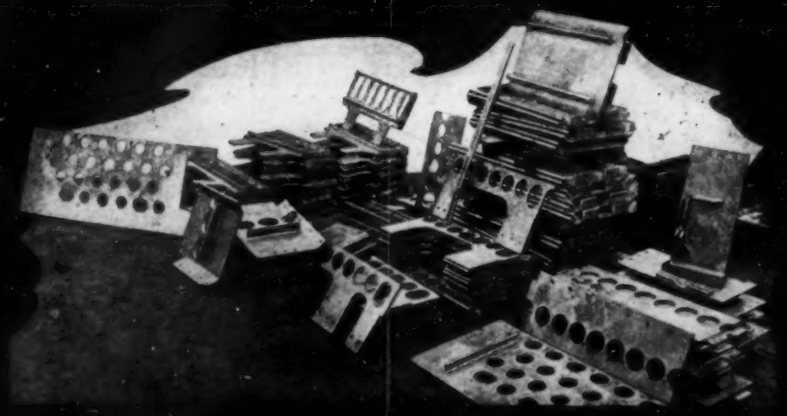
Catalyst cases for production of butadiene from both alcohol and butane;

Separately fired high-temperature and high-pressure superheaters for butadiene production;

Fired and waste-heat boilers for butadiene production;

Alloy furnace castings for all processes;

Pressure vessels for all processes producing butadiene, toluol and high-octane gasoline.



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More than two million pounds of Babcock & Wilcox Tube Support Castings in high-temperature furnaces have been supplied, and not a single service failure has been reported. Service temperatures range as high as 2000 F. under conditions requiring high creep strength, consistent with long-time stability. The castings include all types of supports, together with related links, bolts, nuts, etc.

B&W INTEGRAL FURNACE BOILERS

This type of boiler, a thoroughly coordinated unit of modern design, possesses advantages of especial value in chemical-industry installations. Installation requires minimum alteration of existing structures. A wide variety of fuels is permissible. Particularly notable for their simple, practical construction which makes them exceptionally easy to operate and maintain.

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* *Complete details appear in Bulletin G-17-A, sent free on request.*

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✓ **NO FLOAT SWITCHES — Photoswitch Level Controls operate entirely by electronic relays . . . employ no float switches.**

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✓ **LOW COST — Photoswitch Level Controls are simple and inexpensive to install . . . and over a period of time show the lowest average unit cost.**

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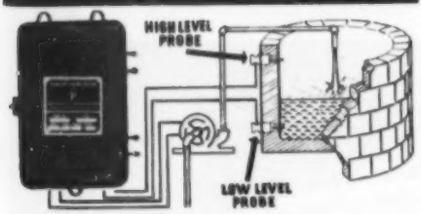

PHOTOSWITCH Electronic Level Controls, effective for all conductive and nonconductive liquids and powders, are available for single-level indication or control, on and off pump control at two levels, and boiler feedwater control.

Probe fittings are attached to the tank at low and high level points, and wired to the PHOTOSWITCH control. When level falls below lower probe, electrical circuit controlling pump is closed, tank fills. When liquid contacts upper probe, fluid acts as conductor of small amount of current, opens circuit, stops pump. For pumping-out control, these operations reversed.

➡ *Write for Level Control Bulletin 1100.*

New Method of LIQUID CONCENTRATE CONTROL

PHOTOSWITCH Concentrate Control checks liquid mixtures right in your tank or vat.

- **Indicates Electronically changes in Liquid Concentrations.**
- **Does away with the necessity of Laboratory "sample batch" testing.**
- **Can be used wherever the Liquids in mixture have any degree of conductivity.**

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PHOTOSWITCH INCORPORATED

PHOTO-ELECTRIC & ELECTRONIC CONTROLS FOR EVERY INDUSTRIAL PURPOSE

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MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Chemicals. Monsanto Chemical Co., St. Louis, Mo.—26th edition of this catalog which contains 170 pages of information on the products put out by the company. Items are listed alphabetically. Each product contains condensed information on its characteristics, railroad classifications, specifications, properties, typical analyses, and industrial uses. Contains chemical names, trade names and formulas. A general technical section includes tables of physical constants for some of the most common chemicals. Also lists other literature available from the company. Very well organized. Illustrated.

Electrical Equipment. Allen-Bradley Co., 1311 S. 1st St., Milwaukee, Wis.—16-page bulletin describing this concern's line of automatic reduced voltage starters. Contains a discussion of the factors that enter into the selection of automatic reduced voltage starters for squirrel cage motors.

Gaskets. Armstrong Cork Co., Lancaster, Pa.—8-page pamphlet dealing with this concern's specialized materials in the industrial line, including gaskets, packings and seals of cork composition, cork-and-synthetics, synthetics, cork-and-rubber, fibrated leather, etc. Contains data on typical applications and representative types of compositions.

Heavy-Media Separation. American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y.—No. 11—28-page ore dressing notebook which deals with the heavy-media separation processes of this concern. Discusses advantages of these processes, applications, preparation of feed, selection of medium and detailed descriptions of heavy-media separation plants in actual operation. Well illustrated by flow-sheets, cross-sectional drawings and contains extensive information in table and text form.

Lathes. South Bend Lathe Works, South Bend, Ind.—Catalog 100B—50-page catalog which describes the entire line of engine lathes, tool-room lathes, and turret lathes put out by this concern. Each size and type is illustrated and fully described. Specifications are tabulated to facilitate selection of the lathe required for any desired application. Attachments, tools and accessories are illustrated and described.

Organic Chemicals. Carbide & Carbon Chemicals Corporation, 30 East 42nd St., New York, N. Y.—1942 and 11th edition of this concern's catalog on synthetic organic chemicals. Contains 100 pages of technical information on nearly 200 synthetic organic chemicals. This edition contains a table of physical properties arranged alphabetically by properties which includes 32 new "research" chemicals and eight products not included in previous editions, together with extensive revisions throughout. Data on each of the products include technical names, formulas, outstanding physical and chemical properties, uses in various industries, specifications and containers, solubility in various materials, etc. Covers, in addition to alcohols, glycols, esters, ketones, aldehydes, and other organic compounds, information on penetrants, "Carbowax" compounds, synthetic resins, activated carbons, hydrocarbons. Well illustrated. An extremely useful booklet which contains information difficult to obtain elsewhere.

Plastics. Bakelite Corporation, 30 East 42nd St., New York, N. Y.—24-page booklet entitled "Bakelite Laminating Plastics" which describes various types of plastics, including molded-laminated stock, engraving sheet stock, fluorescent and phosphorescent sheet stock, and densified-laminated wood. Profusely illustrated with photographs showing manufacture of laminated material and essential uses in electrical, automotive and chemical industries. Contains a chart giving condensed information on physical and electrical properties of laminated phenolic plastics.

Plugging Gas Mains. American Colloid Co., 363 West Superior St., Chicago, Ill.—Data booklet 240—4-page folder which discusses in detail and illustrates the technique of plugging broken gas mains with bentonite. Includes information on experiments on 16-in. and up to 24-in. mains, removal of the bentonite after extinguishment of the fire, characteristics of this concern's "Volclay" bentonite material, preparation of the gel and other similar information.

Power Trucks. Lewis-Shepard Sales Corporation, 505 Walnut St., Watertown, Mass.—8-pages illustrating and describing briefly advantages and applications of this concern's line of electric power trucks. Contains an outline dimensional drawing. Also a similar booklet on gas-powered trucks.

Pumps. The DeLaval Steam Turbine Co., Trenton, N. J.—Catalog B3—12-page booklet which deals with the opposed impeller series pumps of the two-stage centrifugal type put out by this concern. Includes data on units for capacities from 50 gal. to 1,500 gal. per minute and for heads from 80 ft. to 800 ft. Each unit is illustrated and described briefly. Contains a chart giving dimensions of the company's opposed impeller series pumps and heads and deliveries at standard motor speeds.

Reconditioned Equipment. Hirsch Machinery Co., 429-437 Frelinghuysen Ave., Newark, N. J.—4-page folder listing the reconditioned kettles, air compressors, blowers and fans, agitators, vacuum pumps, tanks and other equipment listed by this concern. Includes condensed data on type of equipment, capacity and materials of construction.

Rubber V-Belt Conservation. Allis-Chalmers Mfg. Co., Texrope Division, Milwaukee, Wis.—16-page booklet entitled "Plain Facts on War-Time Care of Rubber V-Belts." Written in non-technical language and illustrated with simple drawings. Written especially for operators who have had no previous experience with V-belts.

Saran Tubing. Hodgman Rubber Co., Framingham, Mass.—Bulletin P1—4-page folder dealing with Saran chemically-resistant plastic tubings and fittings put out by this concern for replacement of stainless steel, brass, aluminum, tin, copper, nickel and rubber. Includes information on sizes from ¼ in. to ¾ in., and recommended uses. Also information on molded Saran fittings, technical data on mechanical properties, thermal and electrical properties, and optical characteristics. Also a chart showing bursting and working pressures versus temperature of the tubing.

Sodium Cyanide. E. I. du Pont de Nemours & Co., Inc., Electrochemical Dept., Wilmington, Del.—72-page spiral-bound notebook which deals with the heat treatment and case-hardening of steel in baths containing sodium cyanide. Gives useful and complete information on cyanide hardening, cyanide reheating and nitriding, heat treating salt, heat coloring, cyanide disposal, safety measures and first aid, salt bath equipment, analytical methods, etc. Contains extensive engineering information in text, chart and diagram form. Extensively illustrated. Well organized.

Steels. Allegheny Ludlum Steel Corporation, Pittsburgh, Pa.—127-page, spiral-bound, handbook on special steels put out by this concern. Incorporates all

pertinent information on various grades of stainless, tool and other special alloy steels. Particularly adapted for use by design engineers and production men, and includes selection data, treatment and use of alloy steels, with finder charts. Also contains information on shoe die steel, Silchrome valve steels, special shapes, Nitralloy steels,' etc. Contains extensive engineering information.

Steel. The Babcock & Wilcox Tube Co., Beaver Falls, Pa.—Booklet TDC119—A complete combined list of standard steels of the American Iron & Steel Institute and the Society of Automotive Engineers, Inc., in the form of a new technical data card.

Sugar Factory Equipment. The Jeffrey Manufacturing Co., Columbus, Ohio—Catalog 766—53-page catalog dealing with equipment for the sugar factory put out by this concern. Each unit or part is illustrated, described briefly, and included in a diagrammatic drawing. The booklet also contains extensive tables on dimensions, list prices, styles, weights, and other similar information on belt idlers, spiral conveyors, and bearings for spiral conveyors, cane shredders and other related equipment.

Terpene Solvents. Hercules Powder Co., Wilmington, Del.—21-page booklet dealing with this concern's terpene chemicals as thinners and solvents for protective coatings. Includes information on bicyclic terpene hydrocarbons, monocyclic terpene hydrocarbons, terpene alcohols, ethers, and ketones. Gives the formula, physical and chemical characteristics, typical analyses, and industrial and recommended uses for each of the groups. Also contains considerable information on blended terpene solvents for use in protective coatings. Includes graphs, charts and tables of technical information.

Wooden Tanks. California Redwood Association, 405 Montgomery St., San Francisco, Calif.—Bulletin 16—4-page section entitled "Redwood Tanks and Vats." Includes illustrations of the use of these wooden tanks for various chemicals, organic acids, leather tanning, soap manufacture, water storage, mining and metallurgy, sulphuric and hydrochloric acids, alkalis, etc. Also contains information on grading of tank lumber, mechanical properties and working characteristics of redwood, and a chart giving average comparative properties of clear redwood compared with a number of other species.

Valves. The Fairbanks Co., Boston, Mass.—6-page folder dealing with this concern's "Faircoseal" bronze valves. Each unit is illustrated and described briefly. Contains a chart of working data.

Vibrating Screen. Robins Conveying Belt Co., Passaic, N. J.—Bulletin 122—12-page booklet illustrating and describing briefly the line of "Vibrex" vibrating screens put out by this concern. Includes drawings, dimension data and other engineering information.

Wear Gage. American Instrument Co., Silver Spring, Md.—Bulletin 2109—4-page folder on the wear gage put out by this concern for measuring amount of material removed from metallic surfaces, such as in engine cylinders and pistons, crankshafts and bearings, gears, etc. Amount of wear that can be measured ranges from 0.0014-0.000015 in. Discusses the instrument, outstanding features, applications and principle of operation.

Welding. Air Reduction, 60 E. 42nd St., New York, N. Y.—14-page reprint showing how, in non-technical language, to reduce wastage of electrodes. Folders are designed to be used as shop posters. Each poster illustrates a common wasteful practice and shows the corresponding good practice.

Wheels and Rollers. American Manganese Steel Division, American Brake Shoe & Foundry Co., 389 E. 14th St., Chicago Heights, Ill.—Bulletin 842WS—24 page catalog on this concern's manganese steel car, conveyor, crane, gear, sheave, sprocket and miscellaneous wheels and rollers. Each unit is illustrated and briefly described.

6 WAYS* TO DO A BIGGER WAR JOB WITH STAINLESS STEEL EQUIPMENT

#1. Specify the Correct Finish For Every Application

Doubly important in these days of Victory Production are the factors which enhance corrosion resistance – save man hours and cleaning time – add to the life of processing equipment.

Surface finish is one of these important factors. An engineer or plant man in selecting equipment for pasteurizing dairy products would expect to have equipment with a higher finish than would an engineer purchasing a heat resistant furnace alloy. In general additional grinding and polishing adds to the corrosion resistance and serviceability of processing equipment.

Higher finishes make equipment easier to clean and reduce adhesion of process materials. In some instances, as in paper making equipment, higher finishes prevent slime growth. In certain applications, polishing eliminates pit corrosion. When selecting a fabricator, choose one who can advise you as to the finish most suitable for your application and who has the special polishing machinery to give your equipment the finish needed for the war job you are doing.

All orders for stainless steel processing equipment are subject to Government priority regulations

To provide the finish required for your application, S. Blickman, Inc., uses a number of specially-designed polishing machines. One of these is illustrated below.

"What to Look for When you Specify Stainless Steel for Your Processing Equipment" summarizes the major factors engineers consider important in getting processing equipment which will do a bigger war job. Copies will be sent free to executives who write for this book on their company stationery.

* *This is the first of a series of advertisements published to guide engineers in getting greater performance from new processing equipment of stainless steel.*

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ERRORS that could be prevented . . . operations that could be speeded up . . . methods that could be improved . . . all of these and others accomplish the ends of the saboteur even if they are unintentional.

Frequently engineers and executives are amazed by the timesaving applications that can be made with modern scales. For modern scales are *much more* than better weighing instruments. They count small parts. They weigh materials and commodities in motion. They read and keep books, making PRINTED RECORDS, much faster and with *unfailing accuracy* impossible for human eyes and hands.

Use your priority to get Fairbanks weighing equipment that will block the invisible saboteur in your plant, *now* — and make money for you in years to come. Fairbanks scale engineers are ready to help you. Fairbanks, Morse & Co., 600 S. Michigan Avenue, Chicago, Illinois.

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WAR REQUIREMENTS CONTINUE TO TAKE INCREASING SHARE OF CHEMICAL INDUSTRY OUTPUT

CHEM & MET ECONOMICS & MARKETS

As our war production moves into high gear and the United States approaches completion of its metamorphosis from a civilian to a military economy, the problem of producing an index which will truly show the activity of the chemical industry becomes increasingly difficult, since fewer and fewer production indicators become publishable. As shown in the *Chem. & Met.* index for industrial consumption of chemicals for August, the latest month for which figures are available, industrial consumption picked up slightly as compared wth the month preceding, but still was somewhat smaller than any other month except February, which represented the low point for the year.

Actually, considering the participation of the chemical industry in the war effort, the pickup was doubtless more, while it is probable that the recession which started in April in *industrial* consumption was far from a recession when all production of the industry is taken into consideration. Unfortunately, even an estimate for certain factors such as military explosives is inadmissable, and so our index necessarily must remain low for the duration by an indeterminate amount.

The manufacture of fertilizers, as shown by superphosphate production, is believed to have increased slightly in August as compared with July. This trend is reported continuing at present. Fertilizer consumption is to be subjected to government control owing to the difficulty of obtaining needed supplies of nitrogen-bearing materials. However, with no likely shortage in either potash or superphosphate, the trend is toward increased consumption of these materials in an effort to offset the unbalance caused by the nitrogen situation.

It is evident that the declining tendency which commenced early in the year in the pulp and paper industry has been interrupted. Production figures for both pulp and paper (except news print and paper board) reached peaks for the last year in January and have since declined with considerable regularity. Paper board production has followed a similar trend except that its decline dated from March which was substantially equal to October 1941 and January. It is possible that excess stocks in consumers' hands are now nearly exhausted.

Superficially the overall picture for glass is somewhat similar, although a part of the industry, containers, is enjoying a production rate not much below the peak for the past 12 months. Window glass production has fallen about one-third from its 1942 peak in April, but plate glass, which hit a crest last October at the start of the last automobile model year, has since declined with only minor swings to less than 25 percent of the October figure.

Although iron and steel production fell slightly from July to August, as marked by our index, and as a result of the tight scrap situation, the trend has since moved slightly in the reverse direction, with the current operating rate of steel companies at a point third highest on record, having been exceeded only during two weeks last May.

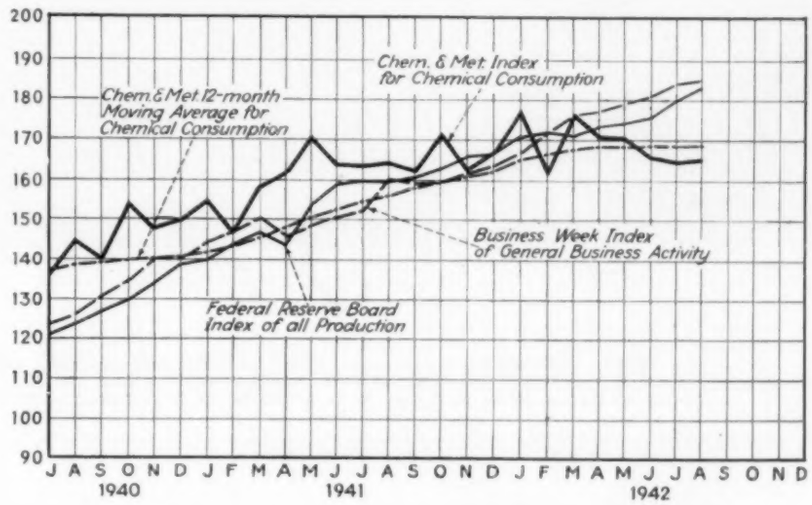
Rayon production in August was slightly less than that of July, the decrease coming in yarn, since staple production was the largest on record. So far, rayon production continues considerably above that of 1941, with a gain through August of about 5 percent compared with the earlier year, according to *Rayon Organon*. In the remaining textile picture, cotton consumption for August was somewhat below the average for the year preceding, while wool fell considerably below the yearly average.

The rate of petroleum refining is in the midst of a slow increase. Paint producers expect a fall up-turn, as recent paint-up campaigns begin to take effect. Only raw materials difficulties are preventing a sharp increase in the indices for rubber and plastics.

To sum up, our chemical consumption index for August stands at 165.32, as compared with 171.01 for May, 166.56 for June, and 164.14 for July. Its all-time peak of 177.12 was reached in January, compared with the peak of 171.48 for 1941 which was reached in October of that year.

Chem. & Met. Index for Industrial Consumption of Chemicals

	July	August
Fertilizers	35.08	35.15
Pulp and paper	17.72	18.70
Petroleum refining	14.42	14.88
Glass	14.54	15.16
Paint and varnish	13.70	13.60
Iron and steel	13.58	13.39
Rayon	15.30	15.17
Textiles	12.37	11.64
Coal products	9.59	9.58
Leather	4.64	4.67
Industrial explosives	5.80	6.08
Rubber	3.00	3.00
Plastics	4.40	4.30
	164.14	165.32

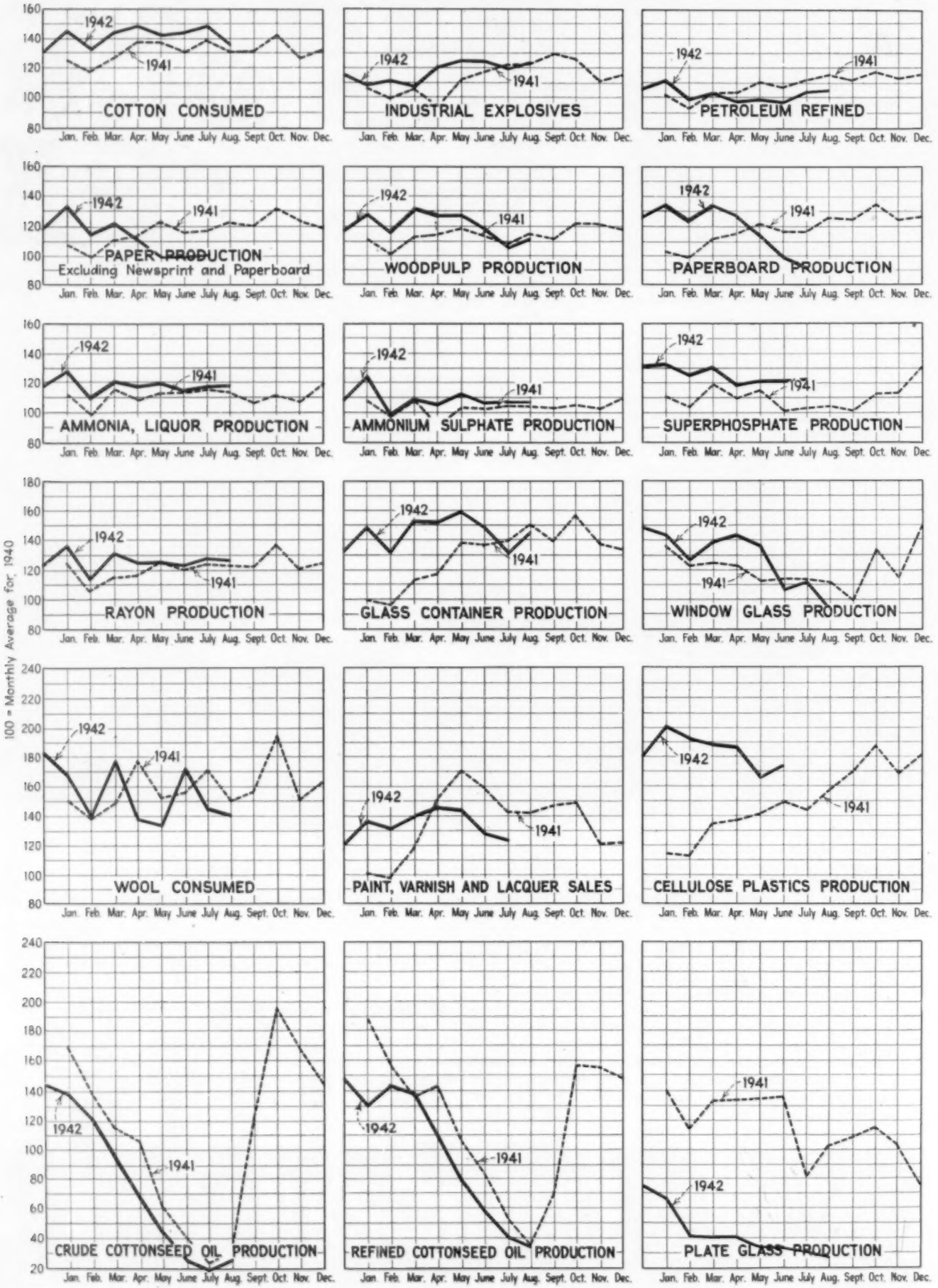


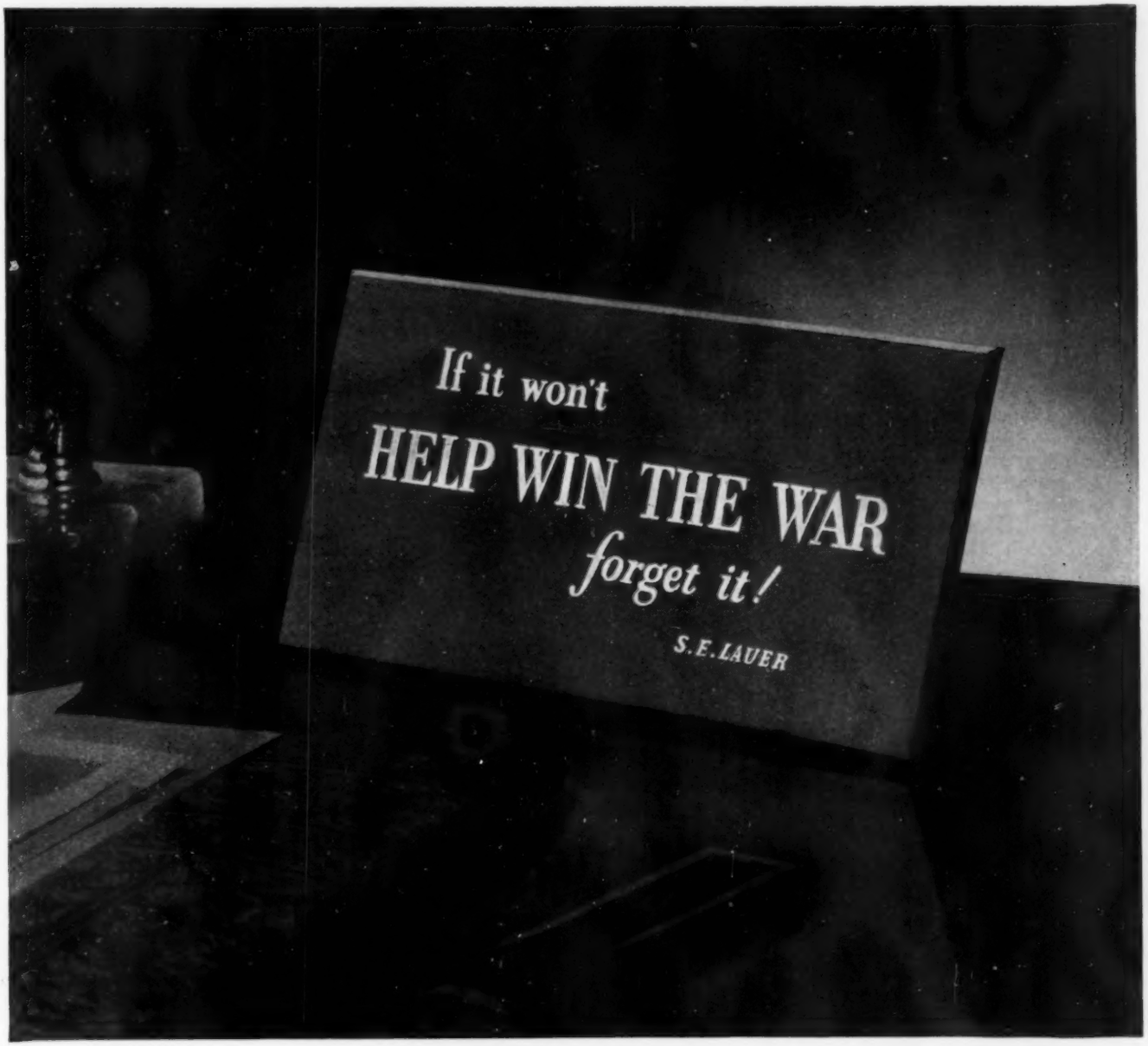
Production and Consumption Data for Chemical-Consuming Industries

	August 1942	August 1941	January-August 1942	January-August 1941	Percent of gain for 1942
Production					
Ammonia, liquor, 1,000 lb.	5,615	5,324	44,701	41,893	6.8
Ammonium sulphate, tons	64,076	62,401	512,255	493,234	3.9
Byproduct coke, 1,000 tons	5,315	5,019	41,173	38,663	6.5
Coal-tar, 1,000 gal.	62,129	59,834	492,596	463,778	6.4
Creosote oil, 1,000 gal.	3,470	3,102	27,271	23,538	15.9
Glass containers, 1,000 gross	6,585	6,791	53,022	44,832	18.5
Plate glass, 1,000 sq. ft.	3,863	14,126	42,971	125,141	65.6*
Window glass, 1,000 boxes	1,075	1,267	11,452	10,909	4.9
Pyroxylin spread, 1,000 lb.	.....	7,142	.....	54,609	....
Woodpulp, tons	796,070	820,838	6,900,987	6,376,287	8.2
Consumption					
Cotton, bales	925,089	874,113	7,649,124	7,008,316	9.2
Industrial explosives, 1,000 lb.	41,709	41,363	316,663	297,406	6.8
Cottonseed oil, bbl.	282,015	250,235	1,889,357	2,650,130	28.7*

* Percent of decline.

Production and Consumption Trends





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RAW MATERIAL AUTHORIZATIONS BY WPB KEPT WITHIN SUPPLY LIMITS FOR FIRST TIME

THE WAR PRODUCTION BOARD announced at the end of September that total raw material authorizations for military and non-military production in the fourth quarter of this year have been kept within the limits of the estimated supply. This, it was stated officially, is the first time that such a balance has been accomplished in advance.

Principles applied by the requirements committee in arriving at particular allotments included:

1—Total requests were kept within total supply.

2—End-use was considered so that items most urgently needed were provided for first.

3—Materials inventory was considered so that reduction in requests was possible in cases where companies had sufficient stock in hand.

4—Reductions in requests for other materials were considered in making final allocations of a particular material, so that each individual cut was as nearly as possible in proper proportion to the others.

The Production Requirements Plan under which the balance was achieved will be continued for the first quarter of 1943, Washington advices state, but the program will be improved upon from time to time to fit into the ever-growing war effort. Sudden revisions, however, are not contemplated, for it is now realized that dislocations in production and manufacture of essential materials must be avoided. Rumors to the effect that PRP is to be abandoned were denied by officials of WPB.

Chemicals essential for producing synthetic rubber will be called for on an unprecedented scale as soon as the findings and recommendations of the Baruch committee that investigated the rubber situation are translated into action. The impact of this development, it is felt, may bring many items into the picture not regarded as essential at the present time. Special arrangements will be made by the Defense Supplies Corp. to obtain needed raw materials and exemptions will be granted by OPA from existing price regulations whenever prevailing prices stand in the way of bringing out the tonnages of such materials required. In other words, handling of the rubber program is expected to be far less rigid pricewise than earlier attempts to secure production for the war effort.

Evidence that the Government intends to relax from the stand taken earlier in the war effort to obtain quick results is seen in the modification of the price regulations for components of furfural. Products affected include cottonseed hulls and hull bran, oat hulls, and other agricultural commodities. Synthetic rubber demand, it was stated by OPA, requires that present productive capacity of furfural be tripled. A new plant is being erected by the Government in the South. Existing maximum prices for cottonseed hulls and hull bran, fixed under the general price regulations, do not permit the manufacturer of furfural to obtain a sufficient supply.

Another modification in the price restrictions occurred during the last month in reference to ethyl alcohol of 188 proof or higher. OPA ruled that the Defense Supplies Corp. could sell to the Government, its agencies or any person using industrial alcohol to fulfill a government contract without complying with the provisions of Revised Price Schedule No. 28, the specific regulation governing certain formulas of the product. All industrial alcohol under the control of WPB, the order states, is to be allocated to the Defense Supplies Corp. for purchase, and this agency either will sell the alcohol for war needs or store it as a stockpile. Exemption of the product from specific price regulation when sold by the Government's agency is desirable to establish an average resale price covering industrial alcohol allocated for war needs.

To increase production of high proof ethyl alcohol, used in the production of explosives and other war materials, Price Administrator Henderson issued a special pricing formula for the relief of whisky distilleries converting their facilities to the production of industrial alcohol.

OPA advised dealers in formaldehyde that sales in containers of the 45-lb. size are subject to the maximum prices established by Revised Price Schedule No. 21, irrespective of whether the containers are full. Certain dealers, it was pointed out, have been evading the specific regulations by assuming that 45-lb. containers that contain less than 45-lb. of formaldehyde are nevertheless subject to Schedule No. 21. The schedule, issued more than a year ago, established the maximum price for formaldehyde at 4¼c. per pound for tank cars, and up to 9½c. for 45-lb. kegs shipped in less than carload lots.

Producers of silver salts obtained relief from prior price regulations on Sept. 22, on which date OPA adjusted

CHEM. & MET. Weight Index of CHEMICAL PRICES

Base=100 for 1937

This month	**109.30**
Last month	109.30
October, 1941	104.05
October, 1940	99.24

Items covered in the weighted index of chemical prices showed no variation of consequence during the last month. Ceiling prices on silver salts were advanced sharply in an order issued by the Office of Price Administration. The change was made to bring the prices in line with the 45c. an ounce maximum on foreign silver.

ceiling prices to conform with the sharp advance in the maximum price of imported silver that went into effect on Aug. 31. The price of foreign silver was raised from 35⅜c. an ounce troy to 45c. as the month of August ended, but no mention was made at that time on the changed status of silver salts.

Cryolite, both natural and synthetic, was put under complete allocation and use control by General Preference Order M-198. A critical shortage of this mineral does not exist at this time, it was explained by WPB, but shipping conditions make it necessary to build adequate stocks for essential needs. Moreover, it was pointed out, much time is required to develop additional production of synthetic cryolite.

Copper chemicals were placed under allocation control during September, to conserve the metal. The order lists copper sulphate, carbonate, chloride, oxide, nitrate, and cyanide. The control became effective Oct. 1. Small order deliveries of copper chemicals may be made by certification from the purchaser to his supplier.

Reflecting rather heavy buying of mercurials by the Government, demand for quicksilver was active throughout the last month. The supply situation in mercury is known to be satisfactory, thanks to high prices now obtaining for the metal. Output in this hemisphere is the largest on record, with producers obtaining from $185 to $191 per flask of 76-lb., f.o.b. mines. The pre-war price of quicksilver averaged nearer $85 per flask.

Freezing of an additional 25 percent of inventory stocks of cocoanut, babassu, and palm kernel oils of all persons who have 240,000 lb. or more on hand has been ordered by the Director General for Operations. Twenty-five percent of all future imports of these oils, or of materials containing them, also has been ordered frozen.

Ceiling prices were named for crude corn, peanut and soybean oils. The maximum prices announced by OPA on these oils, which are contained in Revised Price Order No. 53, effective Sept. 30, conformed with those that prevailed in the open market before the schedule was issued.

CHEM. & MET.
Weighted Index of Prices for
OILS & FATS

Base=100 for 1937

This month	**140.85**
Last month	141.01
October, 1941	175.22
October, 1940	66.95

Maximum prices were set, effective Sept. 30, on crude corn, soybean, and peanut oils. The price ceiling on these oils announced by OPA conformed with current market quotations. Several grades of refined cottonseed oil were lowered under the amended schedule. Crude menhaden oil was easier.

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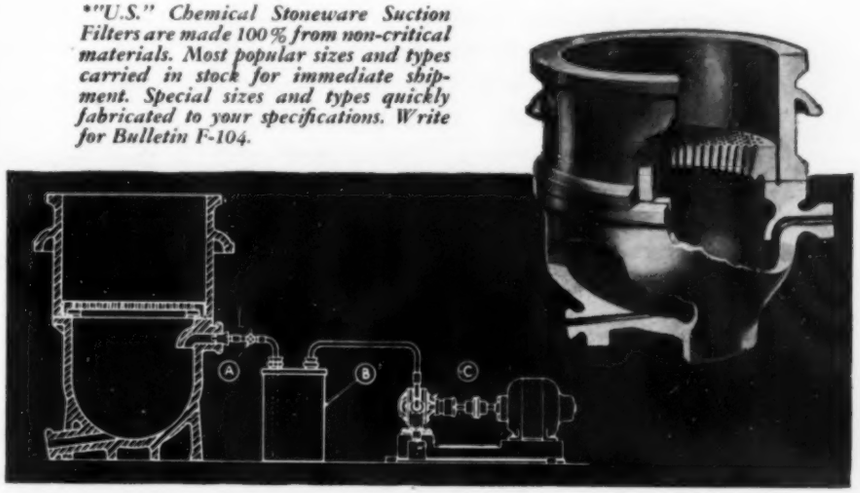

The above sketch shows a simple and effective way of connecting vacuum equipment to suction filters. The lines from the filter to the chemical stoneware surge pot "B", and from the surge pot to the vacuum pump "C", are of glass, with rubber stoppers and sleeve connections. "A" is a three-way release valve. All connections should be treated with shellac or rubber cement. The capacity of the surge pot "B" should be one-fifth the volume of the lower section of the filter, and should be kept one-third filled with water.

Of the many outstanding synthetic, ceramic, rubber and alloy corrosion-resistant materials made by The United States Stoneware Company, "U.S." Chemical Stoneware is one of two that is made entirely from non-critical materials, and for which priorities are not necessarily a pre-requisite to obtain. The substitution of "U.S." chemical stoneware for synthetic, metal and rubber process equipment means more planes, more tanks, more guns . . . and a quicker victory.

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Where Solvents Can Be Recovered

Almost any quantity of solvent vaporized under conditions which permit the vapor-laden air to be collected from the industrial operation can be recovered with the "Columbia" Activated Carbon system, even though vapor concentration is extremely low and water vapor is present. Industries in which the system can be profitably used include: rayon, rubber, plastics, lacquer coating, linoleum, smokeless powder, rotogravure printing, dry cleaning, and solvent extraction of oils.

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If you vaporize solvents in your operations, we can help you determine whether you can recover them profitably with "Columbia" Activated Carbon. We can design and supply a complete recovery plant with guaranteed operating characteristics which permit quick amortization of the cost. Write us about your requirements and let us suggest what and where you can save.

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Great quantities of alcohol are required in the production of smokeless powder for the big guns. Much of that alcohol is made from "high test" cane sugar molasses . . . our largest source of sugar.

To make a gallon of alcohol requires enough molasses to make about thirteen pounds of sugar. Thus every gallon recovered can mean thirteen more pounds of sugar for the needs of the nation.

Each time a 16-inch gun is fired, it eats the equivalent of one-fifth of an acre of sugar cane. A thousand field pieces in an hour's firing can take from American tables as much sugar as would be refined from a field two-thirds of a mile square.

Solvent recovery systems using "Columbia" Activated Carbon will recover for re-use more than 25 per cent of all the alcohol used in smokeless powder production. Millions of gallons will be recovered every month.

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PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

CHEM & MET CURRENT PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.08½–$0.16	$0.13–$0.16	$0.09½–$0.10
Acid, acetic, 28%, bbl., cwt.	3.38 – 3.63	3.38 – 3.63	3.18 – 3.43
Glacial 99.5%, drums	9.15 – 9.40	9.15 – 9.40	8.68 –10.00
U. S. P. X 1, 99.5%, dr.	10.95 –11.20	10.95 –11.20	10.50 –11.00
Boric, bbl., ton	109.00–113.00	108.00–113.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	1.10 – 1.15	1.10 – 1.15	1.05 – 1.15
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb.	.073– .075	.073– .075	.06½– .06¾
Muriatic 18°, tanks, cwt.	1.05 –.....	1.05 –.....	1.05 –.....
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05¼	.05 – .05¼
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –20.00	18.50 –20.00
Oxalic, crystals, bbl., lb.	.11¼– .13	.11¼– .13	.11¼– .13
Phosphoric, tech., c'bys., lb.	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –.....	13.00 –.....	13.00 –.....
Sulphuric, 66°, tanks, ton	16.50 –.....	16.50 –.....	16.50 –.....
Tannic, tech., bbl., lb.	.71 – .73	.71 – .73	.66 – .68
Tartaric, powd., bbl., lb.	.70 –.....	.70 –.....	.70 –.....
Tungstic, bbl., lb.	nom	nom	nom .....
Alcohol, amyl.	.....	.....	.....
From Pentane, tanks, lb.	.131–.....	.131–.....	.131–.....
Alcohol, Butyl, tanks, lb.	.158–.....	.158–.....	.11 –.....
Alcohol, Ethyl, 190 p'f., bbl., gal.	8.19 – 8.25	8.19 – 8.25	6.04 –.....
Denatured, 190 proof	.....	.....	.....
No. 1 special, dr., gal. wks.	.60 –.....	.60 –.....	.33 –.....
Alum, ammonia, lump, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb.	.04 – .04¼	.04 – .04¼	.04 – .04½
Aluminum sulphate, com. bags, cwt.	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt.	1.85 – 2.10	1.85 – 2.10	1.85 – 2.10
Aqua ammonia, 26°, drums, lb.	.02¼– .03	.02¼– .03	.02¼– .03
tanks, lb.	.02 – .02½	.02 – .02½	.02 – .02½
Ammonia, anhydrous, cyl., lb.	.16 –.....	.16 –.....	.16 –.....
tanks, lb.	.04½–.....	.04½–.....	.04½–.....
Ammonium carbonate, powd. tech., casks, lb.	.09½– .12	.09½– .12	.09 – .12
Sulphate, wks., ton	29.20 –.....	29.00 –.....	29.00 –.....
Amylacetate tech., from pentane, tanks, lb.	.145–.....	.145–.....	.135–.....
Antimony Oxide, bbl., lb.	.15 –.....	.15 –.....	.13 –.....
Arsenic, white, powd., bbl., lb.	.04 – .04¼	.04 – .04¼	.04 – .04½
Red, powd., kegs, lb.	nom	nom	nom .....
Barium carbonate, bbl., ton	60.00 –65.00	60.00 –65.00	60.00 –65.00
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb.	.11 – .12	.11 – .12	.10½– .11
Blanc fix, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt.	2.25 – 2.35	2.25 – 2.35	2.00 – 2.10
Borax, gran., bags, ton	44.00 –.....	44.00 –.....	43.00 –.....
Bromine, cs., lb.	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	3.00 –.....	3.00 –.....	3.00 –.....
Arsenate, dr., lb.	.07 – .08	.07 – .08	.07½– .07¾
Carbide drums, lb.	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	18.00 –24.00	18.00 –24.00	19.00 –24.50
flake, bags., del., ton.	18.50 –25.00	18.50 –25.00	20.50 –25.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½–.....	.05½–.....	.05½–.....
Tetrachloride drums, gal.	.73 – .80	.73 – .80	.73 – .80
Chlorine, liquid, tanks, wks., 100 lb.	2.00 –.....	2.00 –.....	2.00 –.....
Cylinders	.05¼– .06	.05¼– .06	.05½– .06
Cobalt oxide, cans, lb.	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b., wks., ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb.	.18 – .20	.18 – .20	.18 – .20
Sulphate, bbl., cwt	5.15 – 5.40	5.15 – 5.40	5.00 – 5.25
Cream of tartar, bbl., lb.	.57 –.....	.57 –.....	.57 –.....
Diethylene glycol, dr., lb	.14 – .15½	.14 – .15½	.22 – .23
Epsom salt, dom., tech., bbl., cwt.	1.90 – 2.00	1.90 – 2.00	1.90 – 2.00
Ethyl acetate, drums, lb.	.12 –.....	.12 –.....	.09½–.....
Formaldehyde, 40%, bbl., lb.	.05½– .06	.05½– .06¼	.05½– .06
Furfural, tanks, lb.	.09 –.....	.09 –.....	.09 –.....
Fusel oil, drums, lb.	.18 – .19	.18 – .19	.17½– .19
Glaubers salt, bags, cwt.	1.05 – 1.10	1.05 – 1.10	1.05 – 1.10
Glycerine, c.p., drums, extra, lb.	.18½–.....	.18½–.....	.19½–.....
Lead:			
White, basic carbonate, dry casks, lb.	.08½–.....	.08½–.....	.07½–.....
White, basic sulphate, sck., lb.	.07½–.....	.07½–.....	.07½–.....
Red, dry, sck., lb.	.09½– .09¾	.09½–.....	.0835–.....
Lead acetate, white crys., bbl., lb.	.12½– .13	.12¼– .13	.12 – .13
Lead arsenate, powd., bag, lb.	.11 – .12	.11 – .12	.09½– .11
Lime, chem., bulk, ton	8.50 –.....	8.50 –.....	8.50 –.....
Litharge, powd., csk., lb.	.08½–.....	.08½–.....	.0735–.....
Lithopone, bags, lb.	.04½– .04¾	.04¼– .04½	.0385– .04
Magnesium carb., tech., bags, lb.	.06½– .06½	.06¼– .06½	.06¼– .06¾

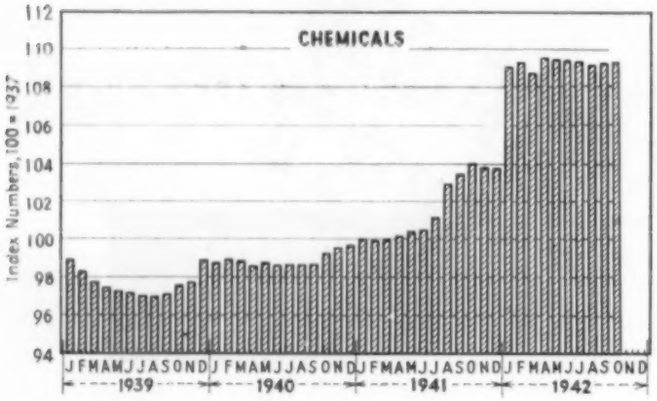
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to October 13

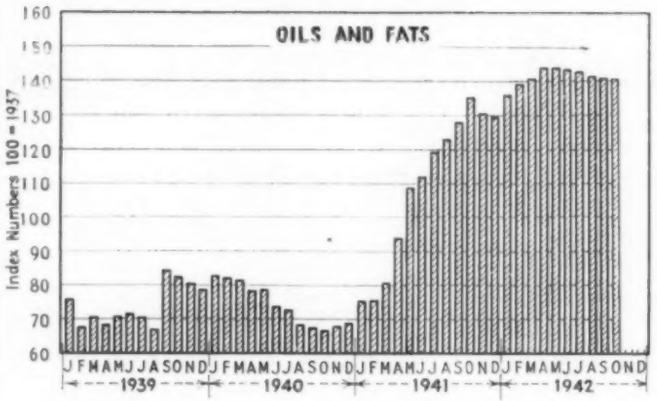
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.60 –.....	.60 –.....	.73 –.....
97%, tanks, gal.	.60 –.....	.60 –.....	.75 –.....
Synthetic, tanks, gal.	.28 –.....	.28 –.....	.24 –.....
Nickel salt, double, bbl., lb.	.13¼– .13½	.13¼– .13½	.13¼– .13½
Orange mineral, csk., lb.	.12½–.....	.12½–.....	.11½–.....
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb.	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb.	.09½– .10	.09½– .10	.09½– .10
Carbonate, 80–85%, calc. csk., lb.	.06½– .07	.06½– .07	.06¼– .07
Chlorate, powd., lb.	.10 – .12	.10 – .12	.10 – .12
Hydroxide (c'stic potash) dr., lb.	.07 – .07¼	.07 – .07¼	.07 – .07½
Muriate, 60% bags, unit	.53½–.....	.53½–.....	.53½–.....
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05¼– .06
Permanganate, drums, lb.	.19½– .20	.19½– .20	.19½– .20
Prussiate, yellow, casks, lb.	.17 – .18	.17 – .18	.17 – .18
Sal ammoniac, white, casks, lb.	.0515– .06	.0515– .06	.0515– .06
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –.....	17.00 –.....	17.00 –.....
Soda ash, light, 58%, bags, contract, cwt.	1.05 –.....	1.05 –.....	1.05 –.....
Dense, bags, cwt.	1.10 –.....	1.10 –.....	1.10 –.....
Soda, caustic, 76%, solid, drums, cwt.	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, del., bbl., lb.	.05 – .06	.05 – .06	.04½– .06
Bicarbonate, bbl., cwt.	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	16.00 –17.00
Bisulphite, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Cyanide, cases, dom., lb.	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb.	.08 – .09	.08 – .09	.08 – .09
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.50 – 2.65	2.50 – 2.65	2.50 – 2.65
Nitrate, bulk, cwt.	1.35 –.....	1.35 –.....	1.47 –.....
Nitrite, casks, lb.	.06¼– .07	.06¼– .07	.06¼– .07
Phosphate, tribasic, bags, lb.	2.70 –.....	2.70 –.....	2.35 –.....
Prussiate, yel. drums, lb.	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.), wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb.	.03 – .03½	.03 – .03½	.03 – .03½
Sulphite, crys., bbl., lb.	.02¼– .02¾	.02¼– .02¼	.02¼– .02¾
Sulphur, crude at mine, bulk, ton.	16.00 –.....	16.00 –.....	16.00 –.....
Chloride, dr., lb.	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb.	.07 – .08	.07 – .08	.07 – .08
Flour, bag, cwt.	1.90 – 2.40	1.90 – 2.40	1.60 – 3.00
Tin Oxide, bbl., lb.	.55 –.....	.55 –.....	.55 –.....
Crystals, bbl., lb.	.39½–.....	.39½–.....	.39½–.....
Zinc, chloride, gran., bbl., lb.	.05½– .06	.05 – .06	.05 – .06
Carbonate, bbl., lb.	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb.	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb.	.10½–.....	.10½–.....	.09½–.....
Zinc oxide, lead free, bag, lb.	.07½–.....	.07½–.....	.06½–.....
5% leaded, bags, lb.	.07½–.....	.07½–.....	.06½–.....
Sulphate, bbl., cwt.	3.85 – 4.00	3.85 – 4.00	3.40 – 3.50

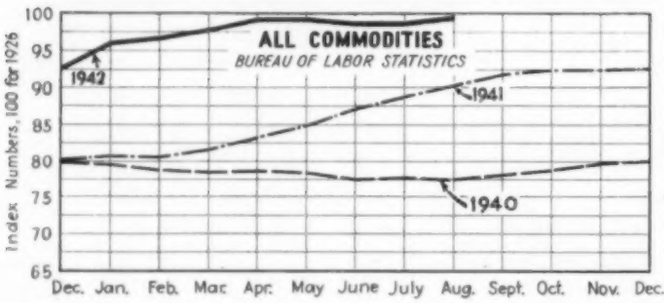
OILS AND FATS

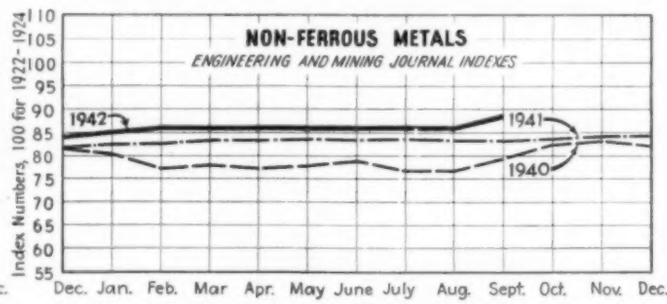
	Current Price	Last Month	Last Year
Castor oil, No. 3 bbl., lb.	$0.13¼–$0.14½	$0.13¼–$0.14½	$0.12½–$0.13
Chinawood oil, bbl., lb.	.38 –.....	.38 –.....	.34 –.....
Coconut oil, Ceylon, tank, N. Y., lb.	nom	nom	.07½–.....
Corn oil crude, tanks (f.o.b. mill), lb.	.12½–.....	.12½–.....	.12½–.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.12½–.....	.12½–.....	.12½–.....
Linseed oil, raw car lots, bbl., lb.	.133–.....	.133–.....	.113–.....
Palm, casks, lb.	.09 –.....	.09 –.....	.08½–.....
Peanut oil, crude, tanks (mill), lb.	.12½–.....	.12½–.....	.13 –.....
Rapeseed oil, refined, bbl., lb.	nom	nom	.15½–.....
Soya bean, tank, lb.	.11½–.....	.11½–.....	.11 –.....
Sulphur (olive foots), bbl., lb.	nom	.19½–.....	.16 –.....
Cod, Newfoundland, bbl., gal.	nom	nom	nom .....
Menhaden, light pressed, bbl., lb.	.117–.....	.114–.....	.112–.....
Crude, tanks (f.o.b. factory) gal.	.64 –.....	.66 –.....	.60 –.....
Grease, yellow, loose, lb.	.08½–.....	.09295–.....	.08½–.....
Oleo stearine, lb.	.09½–.....	.09½–.....	.09½–.....
Oleo oil, No. 1	.11½–.....	.11½–.....	.11½–.....
Red oil, distilled, dp.p. bbl., lb.	.11½–.....	.11½–.....	.12 –.....
Tallow extra, loose, lb.	.08¼–.....	.08¼–.....	.09 –.....

Chem. & Met.'s Weighted Price Indexes








NON-FERROUS METALS
ENGINEERING AND MINING JOURNAL INDEXES
Index Numbers, 100 for 1922-1924
1942
1941
1940
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52– $0.55	$0.52 –$0.55	$0.52 –$0.55
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline, salts, bbl., lb.	.22 – .24	.22 – .24	.22 – .24
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	.85 – .95
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.70 – .75
Benzoic acid, U.S.P., kgs., lb.	.54 – .56	.54 – .56	.54 – .56
Benzyl chloride, tech., dr., lb.	.23 – .25	.23 – .25	.23 – .25
Benzol, 90%, tanks, works, gal.	.15 –.....	.15 –.....	.14 –.....
Beta-naphthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.11 –.....	.11 – .11	.10½– .11
Cresylic acid, dr., wks., gal.	.81 – .83	.81 – .83	.81 – .83
Diethylaniline, dr., lb.	.40 – .45	.40 – .45	.40 – .45
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.23 – .25
Dinitrotoluol, bbl., lb.	.18 – .19	.18 – .19	.18 – .19
Dip oil, 15%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, dr. f.o.b. wks., lb.	.60 –.....	.60 –.....	.70 –.....
H-acid, bbl., lb.	.45 – .50	.45 – .50	.45 – .50
Naphthalene, flake, bbl., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08 – .09
Para-nitraniline, bbl., lb.	.47 – .49	.47 – .49	.47 – .49
Phenol, U.S.P., drums, lb.	.13 –.....	.13 –.....	.13 –.....
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.35 – .40
Pyridine, dr., gal.	1.70 – 1.80	1.70 – 1.80	1.70 – 1.80
Resorcinol, tech., kegs., lb.	.75 – .80	.75 – .80	.75 – .80
Salicylic acid, tech., bbl., lb.	.33 – .40	.33 – .40	.33 – .40
Solvent naptha, w.w., tanks, gal.	.27 –.....	.27 –.....	.27 –.....
Tolidine, bbl., lb.	.86 – .88	.86 – .88	.86 – .88
Toluol, drums, works, gal.	.33 –.....	.33 –.....	.32 –.....
Xylol, com., tanks, gal.	.26 –.....	.26 –.....	.26 –.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech, bbl., lb.	.18 – .19	.18 – .19	.20½– .30
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0335– .30	.0335– .30	.0335– .30
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.36 – .37
Ultramarine blue, bbl., lb.	.11 – .26	.11 – .26	.11 – .26
Chrome green, bbl., lb.	.21½– .30	.21½– .30	.21½– .30
Carmine, red, tins, lb.	4.60 – 4.75	4.60 – 4.75	4.60 – 4.75
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	3.05 – 3.10	3.05 – 3.10	3.20 – 3.25
Chrome yellow, C.P., bbl., lb.	.14½– .15½	.14½– .15½	.14½– .15½
Feldspar, No. 1 (f.o.b.N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 – .10	.08 – .10	.08 – .10
Gum copal Congo, bags, lb.	.09 – .30	.09 – .30	.09 – .30
Manila, bags, lb.	.09 – .15	.09 – .14	.09 – .15
Demar, Batavia, cases, lb.	.10 – .22	.10 – .20	.10 – .22
Kauri, cases, lb.	.18 – .60	.18 – .60	.18 – .60
Kieselguhr (f.o.b. mines), ton.	7.00 –40.00	7.00 –40.00	7.00 –40.00
Magnesite, calc, ton.	64.00 –.....	64.00 –.....	65.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	nom	nom	nom
Rosin, H., 100 lb.	4.01 –.....	3.85 –.....	3.10 –.....
Turpentine, gal.	.64 –.....	.64½–.....	.83 –.....
Shellac, orange, fine, bags, lb.	.39 –.....	.39 –.....	.38 –.....
Bleached, bonedry, bags, lb.	.39 –.....	.39 –.....	.35½–.....
T. N. Bags, lb.	.31 –.....	.31 –.....	.28½–.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc. 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
200 mesh (f.o.b. Ga.), ton.	6.00 – 8.00	6.00 – 8.00	6.00 – 8.00

Industrial Notes

UNITED STATES STONEWARE CO., New York, announces that Herbert D. Schmidt has become affiliated with its sales department.

WORTHINGTON PUMP AND MACHINERY CORP., Harrison, N. J. has appointed R. J. Laidlaw to the position of Manager of its Cleveland district office.

BAILEY METER CO., Cleveland, has opened two new branch offices. One is in Seattle with H. T. Sawyer as manager, the other is in Los Angeles where L. F. Richardson is manager.

JENKINS BROS., Bridgeport, has named Charles C. Chamberlain as general sales manager. His headquarters will be at the general offices of the company, 80 White Street, New York.

WHITING CORPORATION, Harvey, Ill., reports the appointment of R. Elliott Maxwell as Vice-President. He will make his headquarters in New York and will supervise the sales force in the eastern territory.

DIXIE MACHINERY MFG. CO., St. Louis, announces the appointment of T. A. Oberhellmann as Chief Engineer.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., Lamp Division, Bloomfield, N. J., has appointed Ralph R. Brady as manger of the commercial engineering department. D. W. Atwater has been made manager of the new illuminating engineering department.

DETROIT REX PRODUCTS CO., Detroit, has appointed A. O. Thalacker as General Manager. He will continue his duties as Secretary to the company.

UNITED STATES STEEL CORP., Chicago, has changed the name of its new subsidiary, Tubular Products, Inc., to Tubular Alloy Steel Corporation. Benjamin F. Harris is president.

ALLEGHENY LUDLUM STEEL CORP., Pittsburgh, has appointed W. G. McFadden as Acting Manager of the company's Chicago office to replace P. E. Floyd who is now serving with the Government.

KROPP FORGE CO., Chicago, announces the appointment of J. H. Lund as Vice-President. For the past several years Mr. Lund has been in the Kropp Forge sales organization.

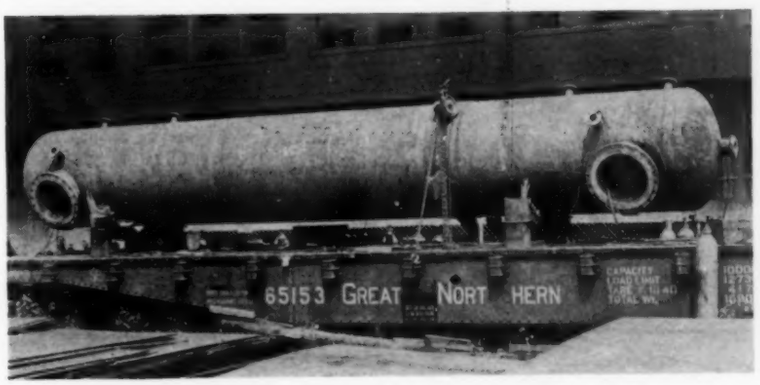
WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., East Pittsburgh, has appointed A. E. Hitchner assistant to the manager of the company's industry sales departments with headquarters at the East Pittsburgh works. He was formerly manager of the Los Angeles office.

WINTHROP CHEMICAL CO., New York, has announced the appointment of C. M. Suter as Director of Chemical Research. Dr. Suter was formerly a professor at Northwestern University.

In place of Rubber LEAD

is unrestricted · · · and highly versatile

The rubber shortage threatens to cripple our war effort. Where rubber is used in process equipment it must be replaced by LEAD, when worn out, for the Government needs it for other purposes. Call KELLEY and get advice on the possibility of substituting LEAD for rubber in your processing equipment. KELLEY HOMOGENEOUS LEAD BONDING will HOLD, under any conditions of pressure, shock and vibration, where lead is suitable. We also furnish lead castings, lead fittings of any size and shape, and install lead for TNT plants, nitrating equipment, acid and chemical plants.



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H. K. Ferguson Company
American Viscose Corporation
North American Rayon Corporation

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LEAD BURNING ANYWHERE IN AMERICA

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Boston, Mass.

CHEM & MET NEW CONSTRUCTION

	Current Projects		Cumulative 1942	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	.....	$140,000	$2,630,000	$4,375,00
Middle Atlantic	.....	385,000	6,961,000	108,136,000
South	$40,000	8,070,000	11,385,000	79,263,00
Middle West	11,090,000	21,030,000	102,645,000	180,875,000
West of Mississippi	1,740,000	16,320,000	186,457,000	378,839,000
Far West	240,000	100,000	20,880,000	136,682,000
Canada	640,000	560,000	14,960,000	2,537,000
	$13,750,000	$46,605,000	$345,918,000	$890,707,000

PROPOSED WORK

Calif., San Francisco—Metten & Gebhardt, 1775 Egbert St., plan to reconstruct their 2 story, 90x350 ft. tannery. Estimated cost $200,000.

Indiana—Jos. E. Seagram & Sons, Inc., Lawrenceburg, is having plans prepared by Smith, Hinchman & Grylls, Marquette Bldg., Detroit, Mich., for the construction of a plant.

La., Claiborne Parish—Big West Drilling Co., Dallas National Bank Bldg., Dallas, Tex., contemplates the construction of a natural gas absorption plant.

Michigan—Headquarters of the Dow Chemical Co., Midland, Mich., plans to construct a plant. Estimated cost $11,000,000.

O., Cleveland—National Metal Abrasive Co., H. Marette, Secy., 3560 Norton Rd., plans to construct a 1 story factory addition. Estimated cost $50,000.

Okla., Barnsdall—Tidewater Associated Oil Co., Drumright; Deep Rock Oil Corp., Cushing; Cushing Refining & Gasoline Co., Cushing, and Johnson Oil & Refining Co., Cleveland, Okla., plan the construction of a 60 mi. 6 in. gasoline pipe line radiating from refineries of owners to Barnsdall. Estimated cost $200,000.

Texas—American Republic Petroleum Co., Petroleum Bldg., Houston, plans to construct a plant. Estimated cost $1,500,000.

Tex., Midland—Gulf Oil Corp., Petroleum Bldg., Fort Worth, plans to reconstruct its oil, gasoline and byproducts plant.

Utah—Utah Oil Refining Co., Utah Oil Bldg., Salt Lake City, plans to construct a plant.

B. C., Woodfibre—B. C. Pulp & Paper Co., Ltd., 682 West Hastings St., Vancouver, plans to construct four plant additions. Estimated cost $60,000.

Ont., Sault Ste Marie—Algoma Steel Corp., Ltd., 7 Wilde Ave., plans to construct a kiln at its brick plant.

Ont., Haley Station—Dominion Magnesium, Ltd., 18 Rideau St., Ottawa, Ont., Can., plans to construct an addition to its plant. Estimated cost $500,000.

Que., Ste Anne de Beaupre—Agricultural Distillery, Ltd., 427 St. Vallier St., Quebec City, plans to remodel its plant here. R. Chenevert, 50 Palace Hill, Quebec City, Archt. Estimated cost $40,000.

CONTRACTS AWARDED

Calif., Patterson—General Dry Battery Co., 1300 Athens St., Cleveland, O., O. E. Lavergne, Local Representative, has awarded the contract for the construction of a magnesium separation plant to Walfrid Knutson, 220 North Third St. Estimated cost $100,000.

Conn., Danbury—Machlett Laboratories, Inc., 1063 Hope St., Springdale, has awarded the contract for alterations and additions to its plant on Grand St., to W. J. Barney, Inc., 101 Park Ave., New York, N. Y. Estimated cost $60,000.

Florida—Trans-Florida Pipeline Co., Dallas, Tex., has awarded the contract for the construction of an 8 in. pipeline from Carrabelle to Jacksonville, across the northern part of the state, to Anderson Bros., Tulsa, Okla. Estimated cost $2,900,000.

Illinois—Chicago Chemical Co., Division of National Aluminite Co., Chicago, has awarded the contract for the construction of a plant to Strobel & Hall, 192 Clark St., Chicago. Estimated cost $700,000.

La., New Orleans—Linde Air Products Co., 828 Howard Ave., has awarded the contract for the construction of a plant to George A. Fuller Co., Inc., Munsey Bldg., Washington, D. C. Estimated cost $70,000.

Louisiana—U. S. Engineer, Courthouse and Post Office, Vicksburg, Miss., has awarded the contract for plant expansion to Commercial Solvents Corp., 17 East 42nd St., New York, N. Y. Estimated cost will exceed $3,000,000.

Mass., Hingham—Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., has awarded the contract for the construction of a 2 story, 40x70 ft. acetylene plant to J. S. Mozzicato, 168 Mystic St., Medford. Estimated cost $40,000.

Mass., Malden—Converse Rubber Co., 392 Pearl St., has awarded the contract for the construction of an addition to its plant and an experimental unit to James Construction Co., 43 Haverhill St., Boston. Estimated cost $40,000.

N. J., Newark—U. S. Industrial Chemical Co., 340 Doreaus Ave., has awarded the contract for the construction of a 3 story mill and dryer building to Damon G. Douglas Co., 605 Broad St. Estimated cost $55,000.

N. Y., New York—Farrand Optical Co., Inc., Bronx Blvd. and East 238th St., has awarded the contract for the construction of an optical goods factory to Brown & Matthews, Inc., 122 East 42nd St. Total estimated cost $250,000.

Ohio—Aluminum Co. of America, Pittsburgh, Pa., has awarded the contract for the construction of a plant to Holmes Construction Co., 443 Palmer St., Wooster. Estimated cost $20,000,000.

Ohio—Electro Metallurgical Co., has awarded the contract for the construction of a plant to Turner Construction Co., 420 Lexington Ave., New York, N. Y.

O., Cleveland—Ferro Enamel Products Co., East 56th St., has awarded the contract for the construction of a group of buildings to Dean W. Rankin, 1836 Euclid Ave. Total estimated cost $250,000.

Pa., Neville Island (br. Pittsburgh)—Vulcan Detinning Co., E. S. Dewey, Plt. Supt., has awarded the contract for the construction of a 1 story, 50x300 ft. factory addition to Pittsburgh-Des Moines Steel Co., Neville Island.

Pa., Philadelphia—Barrett Division of the Allied Chemical & Dye Corp., Margaret and Bermuda Sts., has awarded the contract for the construction of a chemical plant to Lauter Construction Co., G. and Nicetown Lane. Estimated cost $40,000.

S. D., Yankton—Yankton Industrial Alcohol Co. has awarded the contract for the construction of a plant here to Fred H. Jones, Yankton. Estimated cost including equipment $40,000.

Tennessee—U. S. Government, Washington, D. C., has awarded the contract for the construction of a plant to be operated by the Q-O Chemical Co. of Chicago, Ill., to Hegeman Harris Co., Inc., 220 East 42nd St., New York, N. Y. Estimated cost will exceed $3,000,000.

Tennessee—Southern Acid & Sulphur Co., Columbian Mutual Tower, Memphis, has awarded the contract for the construction of a plant to Lummus Co., 420 Lexington Ave., New York, N. Y. Estimated cost $2,000,000.

Texas—Eastern States Petroleum Co., Inc., has awarded the contract for the construction of a plant to Foster-Wheeler Corp., 624 Shell Bldg., Houston, and Tellepson Construction Co., 3900 Clay St., Houston. Estimated grand total cost $4,505,000.

Texas—Goodyear Tire & Rubber Co., Akron, O., and Sinclair Refining Co., Houston, Tex., have awarded the contract for the construction of three plants to Fluor Corp., Mellie Esperson Bldg., Houston; M. W. Kellogg Co., Bankers Mortgage Bldg., Houston, and E. B. Badger Corp., LaPorte Rd., Houston. Estimated cost $875,000, $3,500,000, and $1,500,000 respectively.

Texas—U. S. Government, Washington, D. C., has awarded the contract for the construction of a plant to be operated by the Neches Butane Products Corp. to Foster-Wheeler Corp., Port Arthur. Estimated cost $3,000,000.

Texas—Pure Oil Refining Co. has awarded the contract for the construction of a refinery to Lummus Co., 425 Broadway, Houston. Estimated cost $2,300,000.

Texas—Sinclair Refining Co., Houston, has awarded the contract for the construction of a refinery to M. W. Kellogg Co., Bankers Mortgage Bldg., Houston. Estimated cost $600,000.

Wis., Milwaukee—Eclipse Plastic Industries, 5148 West 23rd St., has awarded the contract for the construction of a 1 story, 73x89 ft. factory to V. Schramka, 4003 North Bartlett Ave.

Ont., Georgetown—Smith & Stone, Ltd., Georgetown, has awarded the contract for the construction of a porcelain plant at the construction of a porcelain plant at & Son, James St. Estimated cost $60,000.

Que., Granby—Miner Rubber Co., Ltd., 191 Denison St., has awarded the contract for the construction of a porcelain plant at G. L. Quay & Freres, Ltd., 437 Guy St., Montreal. Estimated cost $500,000.